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STUDIES IN THE APOCYNACEÆ, VI

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ONE PLATE

KIBATALIA AND ITS IMMEDIATE GENERIC AFFINITIES

The taxonomy of flowering plants has long been distinguished by overwhelming respect for reproductive structures as indicators sine qua non of general relationship and phylogeny. It is not necessary to defend the use of floral characters in the definition of taxonomic entities: the success of such criteria amply justifies their employment. Within single large groups of flowering plants such as families, however, the use of reproductive structures occasionally resolves itself into quibbling comparisons of outline and insignificant variations from a general type idealized as "primitive" by successive writers of successively divergent viewpoints. This futility of approach has been particularly manifest in the efforts of certain students of the phylogeny of the flowering plants.

In the family Apocynaceæ the andrœcia are relatively complicated among flowering plants. The anthers and stigmata are particularly various. Only a bold investigator, in my opinion, can hope to perceive and to interpret rightly a plausible phylogenetic sequence in the intricate floral mechanism alone. Happily such reproductive variants are supported in the Apocynaceæ, and also in the closely related Asclepiadaceæ, by vegetative, chiefly foliar, characters, which clarify intrageneric relationships to a degree that has been little appreciated.

Such characters of the leaves include aggregations of small, fusiform glands found chiefly at the base, less commonly along

the entire length of the ventral surface of the midrib. The distribution of such foliar glands has been extremely useful in the recognition, in particular, of the two subgenera of the tropical American genus *Mandevilla*,[1] reënforcing the less easily observed floral characters. Such characters of the leaves also include peculiar superficial foveæ or pits of generally elliptic shape, which occur with greater or less regularity in the axils of the midrib and primary veins upon the dorsal, or lower, surface. Similar foveæ are infrequently found upon the lower surface of leaves of certain Rubiaceæ as well.

In the Apocynaceæ the foliar foveæ appear to be restricted to six genera: *Forsteronia* and *Tintinnabularia*, which are restricted to tropical America; *Kibatalia* and *Beaumontia*, of tropical Asia and Oceania; *Funtumia*, of Africa; and *Malouetia*, of western Africa and tropical America. The six genera are indubitably closely related, and all are members of the subfamily Echitoideæ. Employing the inclusion or relative degree of exsertion of the anthers as criteria for the erection of two tribes—Echitideæ and Parsonsieæ—within the Echitoideæ, Schumann [2] placed *Kibatalia* (as *Kickxia*) and *Beaumontia* within the Echitideæ, and *Forsteronia*, *Malouetia*, and *Vallaris* (predominantly composed of species referable to *Kibatalia*) within the Parsonsieæ, evidently expressing his view of their natural relationships. More recently Macfarlane [3] has indicated the genus *Vallaris* (vide ante) as derived phylogenetically from the genus *Wrightia; Funtumia* and *Malouetia* as direct lines from the prehistoric plexus of the subfamily Echitoideæ; *Kibatalia* (as *Kickxia*) as derived from *Funtumia; Forsteronia* as derived from *Secondatia* by way of *Thenardia;* and *Beaumontia* as derived from *Baissea*, together with numerous other discrepant genera. It should be observed that *Wrightia, Secondatia, Thenardia, Baissea*, and the genera associated by Macfarlane with *Beaumontia* are destitute of foliar foveæ.

The general aspect of the foliar foveæ has already been noted. The size and the shape vary somewhat among the genera and species demonstrating them (Plate 1, figs. 1–5). In a transverse section (Plate 1, fig. 6) the individual foveæ of *Funtumia elastica* (Preuss) Stapf is seen to be a rather shallow concavity with epidermal cells somewhat larger than those of the foliar epider-

[1] Cf. Woodson, Jr., R. E., Ann. Mo. Bot. Gard. 20 (1933) 613.

[2] In Engler and Prantl, Nat. Pflanzenfam. ed. 1 4[2] (1895).

[3] The Evolution and Distribution of Flowering Plants. Chart 1. Philadelphia (1934).

mis proper. If secretion occurs, it must be relatively minor. Such histological relations have been found in leaf sections of several representative species of the genera *Malouetia, Forsteronia,* and *Funtumia.*

The emphasis upon the structure of the flower in treating of the taxonomy and phylogeny of the flowering plants has been based upon the general assumption that reproductive structures are more conservative than are vegetative structures. As a matter of fact, however, it would appear conversely that vegetative characters are too conservative to be used generally in plant classification; the variability of reproductive structures is more conducive to the recognition of taxonomic categories. Hence it is obvious why the larger divisions of the seed plants, as gymnosperms and angiosperms, monocotyledons and dicotyledons, find their surest foundations upon the anatomy of the root, the stem, and the leaf.

The foliar foveæ of the several genera of Echitoideæ, therefore, appear to be conspicuous, common, anatomical features. Having no evident function at present, they might also be interpreted as vestiges handed down from a common line of ancestors. Were the function of the foveæ obvious, it might be held with reason that they have been evolved independently in incongruent genera as a response to a common need. At any rate they furnish a convenient feature which helps to distinguish a group of genera common to both hemispheres, probably constituting evidence of relationship of the apocynaceous flora of either. Without further phylogenetic implications expressed, the several genera may be distinguished by means of the following:

Key to the foveate-leaved genera of Echitoideæ.

a[1]. Seeds ecomose, glabrous or variously pubescent generally; leaves eglandular; shrubs and small trees; genus of tropical America and Africa ..... *Malouetia.*

a[2]. Seeds comose.

b[1]. Coma chalazal, borne upon an elongate rostrum; leaves not glandular; trees.

c[1]. Corolla salverform to infundibuliform, relatively delicate in texture; stamens exserted, or at least protruding into the inflated corolla throat; genus of tropical Asia and Oceania..... *Kibatalia.*

c[2]. Corolla salverform, relatively fleshy in texture; stamens deeply included; genus of tropical Africa..... *Funtumia.*

b[2]. Coma micropylar, sessile; lianas.

c[1]. Corolla infundibuliform, large and showy; staminal filaments much longer than the anthers.

d[1]. Anthers without elongate, spirally contorted tips; leaves not glandular; genus of tropical Asia..... *Beaumontia.*

d^2. Anthers with elongate, spirally contorted tips; leaves glandular at the base of the midrib above; genus of Central America. *Tintinnabularia.*

c^2. Corolla salverform, relatively small; staminal filaments shorter than the anthers or about as long; leaves mostly glandular at the base of the midrib above; genus of tropical America. *Forsteronia.*

The genera *Forsteronia* and *Malouetia*, the former wholly and the latter predominantly American, have already been revised in a previous number of these studies.[4] *Malouetia* has previously been represented in Africa by a single species, *M. Heudelotii* A. DC., of Sierra Leone and Senegal. Another species from the Belgian Congo may now be added.[5] *Tintinnabularia* is a re-

[4] Ann. Mo. Bot. Gard. 22 (1935) 153–244; 238–270.

[5] **MALOUETIA BEQUAERTIANA Woodson sp. nov.**

Arbuscula (fide Bequaert); ramulis teretibus glabris cortice rubro-brunneis inconspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice breviter acuteque subcaudato-acuminatis basi obtusis 7–19 cm longis 2.8–11 cm latis firmiter membranaceis glaberrimis supra subnitidulis subtus subglaucescentibus in axillis nervi medii inconspicue rareque foveatis; petiolis 0.3–0.6 cm longis; umbellis aut terminalibus aut lateralibus floras albidas 3–9 gerentibus; pedunculo 0.4–0.7 cm longo; pedicellis 1–1.5 cm longis glabris; calycis laciniis ovatis obtusis 0.2–0.25 cm longis valde imbricatis extus intusque papillatis margine minute ciliolatis; corollae salverformis tubo 1.8–2 cm longo basi ca. 0.15 cm diametro metiente paulo sub medio usque ad 0.4 cm diam. dilatato faucibus ampliatis ostio ca. 0.2 cm diametro metiente extus glaberrimo intus basi papillato prope insertionem staminum minute puberulis lobis oblique ovatis acute acuminatis 1.5–1.7 cm longis patentibus extus papillatis intus prope basem puberulis caeterumque puberulo-papillatis; antheris valde exsertis oblongo-ellipticis acutissime sagittatis 0.45 cm longis glaberrimis; ovario oblongo-ovoideo ca. 0.25 cm longo prope apicem minute puberulo-papillato; stigmate 0.2 cm longo; nectariis haud connatis ovario multo brevioribus; folliculis teretibus falcatis saepe subtorulosis 15–20 cm longis glabris; seminibus 2–2.5 cm longis sparse irregulariterque pilosulis.

BELGIAN CONGO, bords boisés de rivière, Stanleyville, February 25, 1915, *Bequaert 6967* (Herb. Jard. Bot. Bruxelles, *type*, Herb. Missouri Bot. Garden, photograph and analytical drawings); Yambuya, forêt, le long de l'eau, March 8, 1906, *Laurent 1023* (Bruxelles); Mondombu, date lacking, *Jespersen 188* (Bruxelles); Romée, February 19, 1906, *Laurent 958* (Bruxelles).

Malouetia Bequaertiana may be distinguished from *M. Heudelotii* as follows:

Corolla tube 1 to 1.2 cm long, not conspicuously inflated toward the base; lobes 1.5 to 1.7 cm long, papillate without, generally puberulent to puberulent-papillate within; plants of the Belgian Congo.... *M. Bequaertiana.*

Corolla tube 1 to 1.2 cm long, not conspicuously inflated toward the base; the lobes 0.8 to 0.9 cm long, glabrous without, minutely puberulent at the very base within, otherwise glabrous; plants of Senegal and Sierra Leone ..... *M. Heudelotii.*

cently discovered monotypic genus of Guatemala.[6] *Funtumia* and *Beaumontia,* consisting of relatively few species of tropical Africa and Asia, respectively, have not yet been the cause of taxonomic difficulties. The situation of *Kibatalia,* however, has been singularly confusing and deserves a somewhat extended revision even upon the imperfect basis of our present knowledge of the tropical Asiatic flora.

Genus KIBATALIA G. Don, char. emend.

Kibatalia G. DON, Gen. Syst. 4 (1838) 86; MERR., Philip. Journ. Sci. 17 (1920) 306.
Hasseltia BLUME, Bijdr. (1826) 1045, non HBK.
Kixia BLUME, Fl. Jav. Praef. 1 (1828) 7; A. DC. in DC., Prodr. 8 (1844) 408, err. typ.
Kickxia BLUME, Rumphia 4 (1848) 25; K. SCH. in Engler and Prantl, Nat. Pflanzenfam. 4[2] (1895) 174, non Dum.
Paravallaris PIERRE, Bull. Soc. Linn. Paris n. s. 1 (1898) 30.
Vallaris Auct., pro parte, non Burm. f.

Lactescent shrubs or trees. Stems ligneous, terete or somewhat compressed; branches opposite or alternate. Leaves opposite, the dorsal surface bearing with more or less frequency a single lenticular or pustulate fovea or pit in the axils of the midrib and secondary veins; nodes inconspicuously stipulate. Inflorescence alternate-lateral or subterminal, rarely terminal, subumbellate, few- to several-flowered. Calyx 5-parted, the lobes essentially equal, cleft nearly to the receptacle, bearing within alternate solitary or clustered squamellæ. Corolla infundibuliform to salverform, the tube cylindrical to narrowly conical, exappendiculate within, the limb actinomorphic, 5-parted, dextrorsely convolute. Stamens 5, the anthers usually more or less exserted, at least protruding conspicuously into the inflated corolla throat, connivent and agglutinated to the stigma, consisting of 2 parallel sporangia borne ventrally near the base of an enlarged, acutely sagittate, peltate connective; pollen granular; filaments free, somewhat shorter than the anther, bearing dorsally near the apex a more or less conspicuous, callose gland. Carpels 2, apocarpous, united at the apex by a common stylar shaft surmounted by the fusiform-subcapitate stigma; ovules numerous, borne upon an axile, binate placenta. Nectaries 5, separate or more or less concrescent. Follicles 2, apocarpous or persistently united at the tips, dehiscing along the ventral suture; containing numerous dry seeds provided with a rostrate, chalazal coma.

[6] Woodson, Jr., R. E., Ann. Mo. Bot. Gard. 23 (1936) 387.

Type species: *Kibatalia arborea* (Blume) G. Don, Gen. Syst. 2 (1838) 86.

The name *Kibatalia* was restored to use in 1920 by Merrill,[7] who assigned appropriate new combinations for most of the valid species previously placed in *Kickxia,* both Asiatic and African, evidently unaware that the latter had previously been taken to constitute the genus *Funtumia* Stapf.

To the Asiatic species of *Kibatalia* have here been added certain species previously relegated to *Vallaris* Burm. f. which show important divergences from the type species of that genus, *V. pergulana* Burm. f., such as the erect fruticose or arboreal habit, the foveate leaves, the subumbellate inflorescence, the rostrate seeds, and structural details of the reproductive organs, all of which are conformable to the generic limits of *Kibatalia. Vallaris lancifolia* Hook. f. has been found to constitute a third generic element, which will be discussed elsewhere.

Key to the species of Kibatalia.

Subgenus I. PARAVALLARIS (Pierre) Woodson

Paravallaris PIERRE, Bull. Soc. Linn. Paris n. s. 1 (1898) 30, pro gen.

Corolla salverform, relatively small; anthers conspicuously exserted.

a[1]. Follicles relatively stout and rigid; species of southeastern continental Asia and Sumatra.

b[1]. Squamellæ solitary, occasionally deeply cleft, alternate with the calyx lobes.

c[1]. Corolla 1.5 to 2 cm long; staminal gland extremely inconspicuous.

d[1]. Peduncles about equaling the subtending petioles; corolla 1.9 to 2 cm long, the lobes oblong-ovate, densely puberulent within; plants of Siam ..... 1. *K. laurifolia.*

d[2]. Peduncles much shorter than the subtending leaves; corolla 1.5 to 1.8 cm long, the lobes puberulent-papillate within; plants of the Malay Peninsula and Sumatra..... 2. *K. Maingayi.*

c[2]. Corolla 2.5 to 2.8 cm long; staminal gland conspicuous; species of Indo-China.

d[1]. Leaves coriaceous, 6 to 14 cm long, the foveæ very conspicuous; anthers minutely pilosulose dorsally..... 3. *K. microphylla.*

d[2]. Leaves firmly membranaceous; 17 to 20 cm long, the foveæ inconspicuous; anthers essentially glabrous dorsally. 4. *K. macrophylla.*

[7] Philip. Journ. Sci. 17 (1920) 306.

b [2]. Squamellæ numerous, indefinitely distributed; corolla 2.9 to 3.1 cm long; staminal gland conspicuous; plants of Burma. 5. *K. anceps.*

a [2]. Follicles relatively slender and flexuous; species of the Philippine Islands.

b [1]. Leaves elliptic-lanceolate, usually narrowly so; floral buds glabrous or indefinitely papillate at the tips; corolla lobes puberulent-papillate within ..... 6. *K. gitingensis.*

b [2]. Leaves elliptic; floral buds puberulent-papillate at the tips; corolla lobes densely puberulent within ..... 7. *K. daronensis.*

Subgenus II. EUKIBATALIA Woodson subgen. nov.

Corolla infundibuliform to subinfundibuliform, relatively large and showy; anthers protruding into the inflated corolla throat or slightly exserted beyond the orifice.

a [1]. Corolla relatively small, 3 to 3.5 cm long; species of the Philippine Islands.

b [1]. Corolla tube somewhat less than 0.1 cm in diameter at the base; leaves membranaceous, elliptic-lanceolate, 2 to 2.5 cm broad. 8. *K. luzonensis.*

b [2]. Corolla tube 0.2 cm in diameter at the base; leaves coriaceous, obovate-elliptic, 3 to 3.5 cm broad..... 9. *K. stenopetala.*

a [2]. Corolla relatively large, 5 to 8 cm long.

b [1]. Squamellæ solitary, occasionally deeply cleft, alternate with the calyx lobes.

c [1]. Nectaries thick and fleshy, shorter than the ovary.

d [1]. Inflorescence several- (usually 4- to 8-) flowered; plants of Borneo ..... 10. *K. borneensis.*

d [2]. Inflorescence few- (usually 1- or 2-) flowered; plants of the Philippine Islands.

e [1]. Corolla throat about equaling the proper tube.

f [1]. Leaves rather narrowly oblong, coriaceous or subcoriaceous.

g [1]. Corolla 7 to 8 cm long, the proper tube rather gradually constricted at the insertion of the stamens, the throat 1.3 to 1.5 cm long..... 11. *K. Merrittii.*

g [2]. Corolla 5 to 6 cm long, the proper tube abruptly constricted at the insertion of the stamens, the throat 0.6 to 0.7 cm long..... 12. *K. Blancoi.*

f [2]. Leaves broadly elliptic, rather delicately membranaceous; corolla 7 to 7.5 cm long, the proper tube rather gradually constricted at the insertion of the stamens, the throat 0.8 to 1 cm long ..... 13. *K. puberula.*

e [2]. Corolla throat much shorter than the proper tube.

f [1]. Corolla throat much wider than the proper tube, 0.7 to 0.9 cm in diameter, the lobes broadly obtuse to rounded. 14. *K. Elmeri.*

f^2. Corolla throat scarcely wider than the proper tube, 0.4 to 0.5 cm in diameter, the lobes acute..... 15. *K. Macgregorii.*

c^2. Nectaries delicately membranaceous, completely concealing the ovary; corolla throat much shorter than the proper tube; plants of the Philippine Islands..... 16. *K. Merrilliana.*

b^2. Squamellæ numerous, indefinitely distributed.

c^1. Leaves lanceolate to oblong-lanceolate, rarely oblong, coriaceous; corolla lobes about 7 cm long; plants of Celebes. 17. *K. Wigmani.*

c^2. Leaves ovate to broadly elliptic, membranaceous; corolla lobes 3.5 to 4 cm long; plants of Java..... 18. *K. arborea.*

The two subgenera are clearly congeneric, as the somewhat slight discrepancy in the size of the flowers and the relative depth of insertion of the stamens are apparently the chief, if not the sole, basis of their distinction.

Through the kindness of the curators I have been privileged to examine critical specimens of *Kibatalia* from several of the leading herbaria of the United States, Europe, and Asia, which are cited by means of the following parenthetical abbreviations: Bureau of Science, Manila, Philippine Islands (BSM); Royal Botanic Gardens, Kew, England (K); Missouri Botanical Garden, Saint Louis, U. S. A. (MBG); Museum National de l'Histoire Naturelle, Paris, R. F. (MP); New York Botanical Garden, New York City, U. S. A. (NY); United States National Herbarium, Washington, U. S. A. (US).

1. KIBATALIA LAURIFOLIA (Ridl.) Woodson.

Kibatalia laurifolia (Ridl.) Woodson, Sunyatsenia 3 (1936) 102.
Trachelospermum laurifolium Ridl., Journ. Fed. Malay States Mus. 5 (1915) 163.

Shrubs (according to Ridley); stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves oblong-elliptic, apex shortly acuminate, base obtuse, 8 to 15 cm long, 2 to 4 cm broad, coriaceous to subcoriaceous, wholly glabrous, lustrous above, opaque beneath; petioles 0.2 to 0.4 cm long; inflorescence 5- to 8-flowered; peduncle about equaling the subtending petioles, essentially glabrous; pedicels 0.6 to 0.8 cm long, very indefinitely papillate to essentially glabrous; calyx lobes broadly ovate, obtuse, 0.2 to 0.25 cm long, very minutely puberulent-papillate to essentially glabrous, the squamellæ solitary, ovate, entire; corolla yellowish (according to Ridley), salverform, the tube flaskform, about 1 cm long, about 0.13 cm in diameter at the base, above which slightly inflated to about 0.2 to slightly above midway, thence gradually narrowed, about 0.12 cm in diameter at the short faucal tube, glabrous without,

puberulent-papillate within towards the insertion of the stamens, the lobes obliquely oblong-ovate, acute to acuminate, 0.9 to 1 cm long, papillate without, densely puberulent within, sharply spreading; anthers conspicuously exserted, 0.25 cm long, minutely hirtellous dorsally, the gland scarcely manifest; ovary ovoid, about 0.1 cm long, minutely puberulent-papillate; stigma 0.07 cm long; nectaries subreniform, essentially separate, less than half equaling the ovary; follicles unknown.

SIAM, Koh Pennan, *Robinson 5764*, 1914 (MP, isotype, MBG, photograph and analytical drawings).

2. KIBATALIA MAINGAYI (Hook. f.) Woodson comb. nov.

Vallaris Maingayi HOOK. F., Fl. Brit. Ind. 3 (1882) 651.

Large trees (according to Maingay); stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves rather broadly elliptic, rarely to broadly oblong-elliptic, apex obtusely subcaudate-acuminate, base obtuse to broadly acute, 6 to 13 cm long, 2 to 5.5 cm broad, coriaceous to subcoriaceous, glabrous throughout; petioles 0.4 to 0.5 cm long; inflorescence 3- to 10-flowered; peduncle scarcely manifest, much shorter than the subtending petioles, glabrous; pedicels 0.5 to 0.8 cm long, glabrous; calyx lobes ovate, acute, 0.18 to 0.2 cm long, papillate without, the squamellæ solitary and alternate with the calyx lobes, ovate-quadrate, entire to minutely lacerate; corolla white (according to Hooker), salverform, the tube cylindric-flaskform, 0.65 to 0.8 cm long, about 0.15 to 0.2 cm in diameter at the base, slightly narrowing toward the insertion of the stamens, essentially glabrous without, within puberulent towards the insertion of the stamens, otherwise puberulent-papillate, the lobes obliquely ovate, obtuse to shortly acute, 0.9 to 1.1 cm long, puberulent-papillate without and within, reflexed or sharply spreading; anthers conspicuously exserted, 0.25 to 0.3 cm long, minutely barbellate towards the tip, the gland very inconspicuous; ovary oblong-ovoid, about 0.15 cm long, minutely puberulent; nectaries deeply 5-lobed, essentially concrescent, somewhat shorter than the ovary; follicles relatively stout and rigid, 22 to 28 cm long, about 0.4 to 0.7 cm in diameter, sharply divaricate, acuminate, glabrous; seeds 4 to 4.5 cm long, the rostrum about equaling the length of the seed, the pale yellow coma 5.5 to 6 cm long.

Malaya. JOHORE, Penyabong, *Foxworthy 1174*, May, 1918 (BSM). PENANG, Batu Feringy, *Curtis 12569*, 1897 (BSM). SINGAPORE, *Ridley 4917*, garden jungle, 1893 (BSM); same lo-

cality, *Curtis s. n.*, 1905 (BSM, MBG); data incomplete, *Gandoger s. n.*, July, 1906 (MBG).

SUMATRA, Loendoet Concession, Koealoe, *Bartlett 7124*, March 31, 1927 (NY).

3. KIBATALIA MICROPHYLLA (Pitard) Woodson comb. nov.

Paravallaris microphylla PITARD, in Lecomte, Fl. Gén. Indo-Chine 3 (1933) 1181.

Small trees, 5 to 10 m tall (according to Pitard); stems relatively stout, glabrous, very inconspicuously lenticellate when fully mature; leaves oblong-elliptic, apex obtusely acute to very shortly and obtusely acuminate, base obtuse to acute, 6 to 14 cm long, 2 to 5 cm broad, rather heavily coriaceous, wholly glabrous; petioles 0.3 to 0.5 cm long; inflorescence 3- to 5-flowered; peduncle somewhat shorter than the subtending leaves, glabrous; pedicels 0.7 to 1 cm long, glabrous; calyx lobes broadly oval, obtuse, minutely puberulent-papillate without, 0.3 to 0.35 cm long, the squamellæ solitary and alternate with the calyx lobes, entire or essentially so; corolla salverform, white (according to Pitard), the tube cylindric-flaskform, 1.2 to 1.3 cm long, about 0.2 to 0.225 cm in diameter at the base, constricting to about 0.15 cm in diameter at the orifice, essentially glabrous without, puberulent towards the insertion of the stamens within, the lobes obliquely obovate-elliptic, obtuse, 1.3 to 1.4 cm long, minutely papillate without, minutely puberulent within, reflexed or sharply spreading; anthers conspicuously exserted, 0.3 cm long, minutely pilosulose dorsally, the gland obscurely binate, subreniform; ovary ovoid, about 0.1 cm long, minutely puberulent; nectaries concrescent, indefinitely lobed, about one-third equaling the ovary; immature follicles relatively stout and rigid, obtuse, essentially glabrous; seeds unknown.

French Indo-China. ANNAM, Nha-trang Province, Hoa-tan, *Poilane 47*, June 23, 1919 (MP, type, NY, MBG, photograph); Phu-hu, *Poilane S423*, January 22, 1923 (MP, NY); Tourane and vicinity, forest, *Clemens and Clemens 4344*, May to July, 1927 (MBG, NY, US).

4. KIBATALIA MACROPHYLLA (Pierre) Woodson comb. nov.

Paravallaris macrophylla PIERRE, in Planch., Prod. Apocyn. (1894) 325; PITARD, in Lecomte, Fl. Gén. Indo-Chine 3 (1933) 1180.

Shrubs, 2 to 6 m tall (according to Pitard); stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves broadly oblong-elliptic, apex very shortly and obtusely

subcaudate-acuminate, base obtuse, 17 to 20 cm long, 4 to 9 cm broad, firmly membranaceous, minutely puberulent-papillate beneath when very young, wholly glabrous when fully mature; petioles 0.5 to 0.7 cm long; inflorescence 4- to 10-flowered; peduncle somewhat shorter than the subtending petioles, essentially glabrous; pedicels 0.8 to 1.1 cm long, essentially glabrous to very minutely and irregularly pilosulose; calyx lobes ovate, broadly acute to obtuse, 0.3 to 0.35 cm long, puberulent-papillate without, the squamellæ solitary and alternate with the calyx lobes, more or less irregularly lacerate and divided; corolla salverform, yellowish white (according to Pitard), the tube cylindric-flaskform, 1 to 1.2 cm long, about 0.3 cm in diameter at the base, constricting to about 0.15 cm in diameter at the orifice, essentially glabrous without, minutely puberulent within towards the insertion of the stamens, the lobes obliquely oblong-elliptic, acuminate, 1.5 to 1.6 cm long, minutely puberulent-papillate without, densely and minutely puberulent within, reflexed or sharply spreading; anthers conspicuously exserted, 0.3 to 0.325 cm long, essentially glabrous dorsally, the gland conspicuous, binate-ovoid; ovary ovoid-oblongoid, about 0.15 cm long, minutely puberulent; nectaries concrescent, irregularly lobed, about half equaling the ovary; follicles relatively stout and rigid, 8 to 17 cm long, about 0.6 to 0.8 cm in diameter, divaricate, obtusish, glabrous; seeds 1.5 to 2 cm long, the rostrum 3 to 3.5 cm long, the very pale yellowish or white coma 5 to 5.5 cm long.

French Indo-China. ANNAM, Thanth-Hoa Province, Hoi-Xuan, *Poilane 1752,* August 17, 1920 (MP, NY); Vinh-Yen Province, *Eberhardt 3801,* no date (MP, NY); Tuyen Quang, *Petelot 1934,* June, 1925 (NY); Hoa Binh Province, route de Hoa Binh, *Petelot 4921,* January, 1931 (NY).

Although the foliage appears to conform, the follicles of *Petelot 4921* are much smaller than those of *Poilane 1752* and evidently somewhat more compressed as well.

5. KIBATALIA ANCEPS (Dunn and R. Williams) Woodson.

Kibatalia anceps (Dunn and R. Williams) WOODSON, Sunyatsenia 3 (1936) 101.

Vallaris ? anceps WALL., Cat. (1828) No. 1622, nom. nud.

Trachelospermum anceps DUNN and R. WILLIAMS, Kew Bull. (1920) 343.

Vallaris arborea FISCHER, Kew Bull. (1927) 92.

Vallaris anceps (Dunn and R. Williams) FISCHER, Kew Bull. (1931) 28 [where cited as *V. anceps* (Wall.) Fischer].

Trees (small, according to Dunn and R. Williams; 40 feet tall, according to Fischer); stems relatively stout, minutely puberulent when young, eventually becoming glabrate; leaves oblong-elliptic, apex shortly acuminate, base obtuse, 15 to 25 cm long, 4.5 to 8.5 cm broad, subcoriaceous, rather lustrous and glabrous above, opaque and densely puberulent beneath; petioles 1 to 1.2 cm long, minutely puberulent to glabrate; inflorescence 5- to 8-flowered; peduncle about equaling the subtending petiole, minutely puberulent; pedicels 1.8 to 2 cm long, minutely puberulent; calyx lobes ovate, obtuse, 0.4 to 0.5 cm long, minutely and densely puberulent without, the squamellæ numerous, regularly and indefinitely distributed; corolla salverform, essentially glabrous to very indefinitely papillate without, the tube somewhat conical, 1.2 to 1.3 cm long, about 0.6 cm in diameter at the base, and 0.2 cm in diameter at the orifice, puberulent within above, the lobes obliquely ovate, obtuse, 1.7 to 1.8 cm long, about 1 cm broad, very minutely papillate without, puberulent-papillate within, sharply spreading; anthers 0.35 cm long, conspicuously exserted, minutely hirtellous dorsallly, the gland subreniform, entire, about one-fifth equaling the anther; ovary broadly ovoid, about 0.15 cm tall, puberulent-papillate; stigma fusiform, 0.15 cm long; nectaries somewhat concrescent, nearly equaling the ovary; follicles relatively stout, 15 to 19 cm long, about 1 cm in diameter, glabrous, sharply divaricate; seeds about 5 to 2 cm long, the slender rostrum slightly surpassing the region of the embryo, the pale tawny coma about 6 cm long.

INDIA, Burma, South Tenasserim, Ngawun Chaung forests, altitude 300 feet, *Parkinson 1632,* January 26, 1926 (K, MBG, photograph); Letpanthaung, *Meebold 14654,* March, 1911 (K, cotype).

6. KIBATALIA GITINGENSIS (Elm.) Woodson comb. nov.

Kickxia gitingense ELM., Leafl. Philip. Bot. 4 (1912) 1455.
Vallaris angustifolia MERR., Philip. Journ. Sci. 7 (1912) 335.
Vallaris gitingensis (Elm.) MERR., Philip. Journ. Sci. 10 (1915) 70.

Trees, 5 to 20 m tall (according to collectors); stems relatively slender, glabrous, very inconspicuously lenticellate when fully mature; leaves elliptic-lanceolate, usually very narrowly so, apex obtusely subcaudate-acuminate, base acute to attenuate, 3 to 12 cm long, 1 to 3 cm broad, subcoriaceous, glabrous throughout; petioles 0.2 to 0.5 cm long; inflorescence 4- to 12-flowered; peduncle somewhat shorter than the subtending petioles, gla-

brous; pedicels 0.5 to 1 cm long, glabrous; calyx lobes ovate, acute to obtuse, minutely papillate to puberulent-papillate without, the squamellæ solitary, alternate, dentiform, very inconspicuous; corolla salverform, creamy white (according to Elmer), the tube flaskform, 0.6 to 0.8 cm long, about 0.15 cm in diameter at the base, somewhat inflated towards midway, thence gradually constricted, about 0.1 to 0.125 cm in diameter at the orifice, glabrous without, minutely puberulent towards the insertion of the stamens within, the lobes obliquely ovate-elliptic, obtuse to broadly acuminate, 0.7 to 1.2 cm long, minutely papillate to essentially glabrous without, minutely puberulent to puberulent-papillate within, reflexed to sharply spreading; anthers conspicuously exserted, 0.2 to 0.25 cm long, essentially glabrous dorsally, the gland conspicuous, ovoid-subreniform; ovary ovoid, about 0.1 cm long, puberulent to puberulent-papillate; nectaries distinctly 5-cleft, about equaling to about half equaling the ovary; follicles relatively slender and flexuous, long-acuminate, 11 to 25 cm long, about 0.25 to 0.4 cm in diameter, divaricate to falcate, glabrous; seeds 1.5 to 2 cm long, the rostrum 4 to 5 cm long, the pale tawny coma 5 to 7 cm long.

Philippine Islands. LUZON, Laguna Province, *F. B.*[8] *22503 Mariano*, February and March, 1911 (BSM), *Manuel* (BSM): Camarines Sur Province, Agosais, *Bur. Sci. 76127 Edaño*, on slope in damp forest, altitude 1,500 feet, October, 1928 (BSM, NY); Guinobatan, *F. B. 27241 Palma*, July, 1918 (BSM): Camarines Norte Province, Paracale, *Bur. Sci. 33515 Ramos and Edaño*, damp forests, November and December, 1918 (BSM, US): Ilocos Norte Province, Burgos, *Bur. Sci. 32908 Ramos*, dry thickets, July, 1918 (BSM): Tayabas Province, Mauban, San Jose, Bia-an, on the mountain ridges where the soil is deep and loose, altitude 400 meters, *F. B. 25565 Duldulao*, May, 1916 (BSM, US); Lucban, Mount Banahao, mountain forest, altitude 2,000 meters, *Bur. Sci. 19537 Ramos*, January 31, 1913 (BSM, US): Sorsogon Province, Irosin, Mount Bulusan, *Elmer 15910*, April, 1916 (BSM, MBG, NY); Mount Pocdol, altitude 130 meters, damp forests, *Bur. Sci. 23434 Ramos*, July and August, 1915 (BSM, MBG, NY, US). CATANDUANES, Barrio Agbau, *F. B. 28829 Borja*, January 19, 1922. SIBUYAN, Magallanes, Mount Giting-Giting, *Elmer 12203* (MBG, NY, US, isotypes). LEYTE,

[8] *F. B.*, Bureau of Forestry, or *Bur. Sci.*, Bureau of Science, is followed by Bureau of Science herbarium number and the collector's name.

Buenavista, forest, altitude 500 meters, *Wenzel 678*, May 15, 1914 (BSM). MINDANAO, Surigao Province, *Wenzel 2554*, June 26, 1924 (BSM, MBG, NY).

7. KIBATALIA DARONENSIS (Elm.) Woodson comb. nov.

Holarrhena daronensis ELM., Leafl. Philip. Bot. 4 (1912) 1455.
Vallaris daronensis (Elm.) MERR., Philip. Journ. Sci. 10 (1915) 70.

Trees, 5 to 20 m tall (according to collectors); stems relatively slender, glabrous, rather inconspicuously lenticellate when fully mature; leaves elliptic, apex shortly and obtusely subcaudate-acuminate, base acute to obtuse, 4 to 10 cm long, 1.5 to 4 cm broad, subcoriaceous, glabrous throughout; petioles 0.4 to 0.6 cm long; inflorescence 3- to 7-flowered; peduncles somewhat shorter than the subtending leaves, glabrous; pedicels 0.4 to 0.6 cm long, glabrous; calyx lobes ovate, obtuse, 0.25 to 0.3 cm long, indistinctly papillate without, the squamellæ alternate with the calyx lobes, solitary; corolla salverform, white (according to Elmer), the tube (in buds shortly before anthesis) cylindric-flaskform, 0.6 to 0.7 cm long, about 0.1 cm in diameter at the base, gradually narrowing to about 0.07 cm in diameter at the orifice, essentially glabrous without, minutely puberulent at the attachment of the stamens within, the lobes obliquely elliptic-ovate, acute, 0.7 to 0.8 cm long, minutely puberulent-papillate without, densely puberulent within, reflexed or sharply spreading; anthers conspicuously exserted, 0.25 cm long, minutely barbellate at the tips, the gland narrowly subreniform, relatively conspicuous; ovary ovoid-oblongoid, about 0.1 cm long, minutely and sparsely pilosulose; nectaries concrescent, irregularly 5-lobed, about half equaling the ovary; follicles relatively slender and flexuous, long-acuminate, 25 to 40 cm long, about 0.35 to 0.5 cm in diameter, divaricate to falcate, glabrous; seeds about 2 cm long, the rostrum 2.5 to 3 cm long, the very pale tawny coma 6 to 8 cm long.

Philippine Islands. MINDANAO, Davao District, Mount Apo, *Elmer 11912*, October, 1909 (MBG, NY, isotypes): Agusan Province, So. Vitus, along Vitus Creek, *F. B. 31308 Genove*, July 19, 1927 (BSM): Lanao Province, Lake Lanao, at base of wooded hill, *Clemens s. n.*, May, 1907 (BSM): Misamis Province, *Quadras s. n.*, no date (BSM).

8. KIBATALIA LUZONENSIS Woodson sp. nov.

Arborea ut dicitur alt. 10 m attingens; ramulis gracilibus omnino glaberrimis maturitate obscure lenticellatis; foliis breviter

petiolatis elliptico-lanceolatis apice obtuse subcaudato-acuminatis basi acutis obtusisve 6–9 cm longis 1.5–2.5 cm latis membranaceis omnino glaberrimis; petiolis 0.4–0.5 cm longis; inflorescentiis 1- (2-) floris; pedunculo subnullo; pedicellis 0.8–1 cm longis, glaberrimis; calycis laciniis late ovatis obtusis, 0.25–0.3 cm longis, glabris squamellis solitariis alternatis irregulariter laciniatis; corollae salverformis ut dicitur albidae tubo cylindrico 1–1.1 cm longo basi ca. 0.08 cm diametro metiente faucibus paululo ampliatis ca. 0.1 cm diametro metientibus extus glaberrimo intus prope insertionem staminum minute puberulo lobis oblique linearielliptics acuminatis 2.5–2.7 cm longis, 0.2–0.3 cm latis intus basi puberulo-papillatis caeterumque glabriusculis; antheris in corollae faucibus inclusis 0.4–0.425 cm longis minute sparseque barbellatis glandula integra valde manifesta; ovario ovoideo-oblongoideo ca. 0.1 cm longo, glabro; nectariis concrescentibus regulariter 5-lobatis ovario subaequantibus; foliculis ignotis.

Philippine Islands. LUZON, Laguna Province, Majayjay, in virgin forest, altitude 3,000 feet, *Bur. Sci. 75041 Rivera and Duyag*, June 20, 1928 (BSM, type, MBG, photograph and analytical drawings).

9. KIBATALIA STENOPETALA Merr.

Kibatalia stenopetala MERR., Philip. Journ. Sci. 17 (1920) 308.

Small trees 5 m tall (according to Merrill); stems relatively slender, glabrous, inconspicuously lenticellate when fully mature; leaves obovate-elliptic, apex obtuse to very shortly and obtusely subcaudate-acuminate, base obtusely to acutely cuneate, 6 to 9 cm long, 2 to 3.5 cm broad, rather heavily coriaceous, wholly glabrous; petioles 0.4 to 0.5 cm long; inflorescence 1- or 2-flowered; peduncle somewhat shorter than the subtending petioles, glabrous; pedicels 1.7 to 2 cm long, glabrous, calyx lobes broadly ovate, obtuse, 0.15 to 0.2 cm long, essentially glabrous without the squamellæ, solitary, subentire, alternate with the calyx lobes; corolla subinfundibuliform, white (according to Merrill), the tube (sensu latiore) 0.9 to 1 cm long, about 0.2 to 0.225 cm in diameter at the base, somewhat inflated above the insertion of the stamens, about 0.25 cm in diameter at the orifice, essentially glabrous without, minutely puberulent above the insertion of the stamens within, the lobes obliquely linear-elliptic, acuminate, 2 to 2.3 cm long, 0.3 to 0.4 cm broad, spreading, essentially glabrous without minutely puberulent towards the base within; anthers inserted at about the lower third of the corolla tube (sensu latiore), 0.55 to 0.6 cm long, sparsely and very minutely

barbellate, the gland compressed-ovoid, relatively conspicuous; ovary ovoid, about 0.15 cm long, very sparsely and irregularly pilosulose; nectaries concrescent, indefinitely and irregularly lobed, sparsely and irregularly ciliate, about half equaling the ovary; follicles unknown.

Philippine Islands. MINDANAO, Surigao Province, along streams at low altitudes at the iron deposit on the northeast coast, *Bur. Sci. 34691 Ramos and Pascasio,* June 14, 1919 (US, isotype, MBG, photograph and analytical drawings).

10. KIBATALIA BORNEENSIS (Stapf) Merr.

Kibatalia borneensis (Stapf) MERR., Philip. Journ. Sci. 17 (1920) 309.

Kickxia borneensis STAPF, in Hook., Ic. 27 (1901) *pl. 2693.*

Shrubs (about 18 dm tall according to Stapf); branches relatively stout, glabrous, leaves opposite, shortly petiolate, oblong-elliptic, apex shortly and obtusely subcaudate-acuminate, base obtuse, 10 to 15 cm long, 3 to 4.5 cm broad, coriaceous, glabrous, nitidulous above, opaque beneath; petioles 0.4 to 0.5 cm long, glabrous; inflorescence lateral, alternate, subumbellate, bearing 4 to 8 rather showy flowers; peduncle shorter than the subtending petioles, glabrous; pedicels 0.3 to 0.4 cm long, glabrous, greatly accrescent in fruit; bracts extremely inconspicuous; calyx lobes ovate-elliptic, acute, 0.3 to 0.4 cm long, slightly foliaceous, glabrous or essentially so, the squamellæ solitary, alternate; corolla infundibuliform, glabrous without, the proper tube 1.5 cm long, about 0.2 cm in diameter at the base, the throat conical-campanulate, 1.3 cm long, about 0.6 cm in diameter at the orifice, the lobes obliquely oblong-dolabriform, obtuse, 1.5 cm long, slightly spreading; stamens inserted at the base of the corolla throat, the anthers elliptic, 0.6 cm long, essentially included, glabrous; ovary oblong-ovoid, about 0.2 cm long, glabrous; nectaries about half equaling the ovary; stigma 0.1 long; follicles relatively stout, 14 to 15 cm long, glabrous without; seeds unknown.

BORNEO, Sarawak, data incomplete, *Lobb s. n.* (K, type, MBG, photograph).

11. KIBATALIA MERRITTII (Merr.) Woodson comb. nov.

Kickxia Merrittii MERR., Philip. Journ. Sci. 4 (1909) 315.

Trees, 15 m tall (according to collectors); stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves oblong-elliptic, apex obtuse to very shortly and

obtusely subcaudate-acuminate, base obtuse to acute, 6 to 10 cm long, 1.3 to 3 cm broad, firmly membranaceous, glabrous throughout; petioles 0.5 to 0.8 cm long; inflorescence 1- or 2-flowered; peduncle scarcely manifest; pedicels 1.5 to 1.7 cm long, glabrous, calyx lobes ovate, obtuse, papillate without, 0.4 to 0.45 cm long, the squamellæ alternate, solitary; corolla infundibuliform, white (according to collectors), the proper tube 1.2 to 1.5 cm long, about 0.6 cm in diameter at both base and orifice, glabrous without and within, the throat cylindric, 1.5 to 1.7 cm long, about 0.8 cm in diameter at the orifice, indefinitely papillate to essentially glabrous without, minutely puberulent-papillate within, puberulent at the insertion of the stamens, the lobes obliquely elliptic, acute to acuminate, 4.5 to 5 cm long, 1.3 to 1.5 cm broad, essentially glabrous; anthers 0.6 to 0.65 cm long, glabrous dorsally, or very minutely and sparsely barbellate, the gland compressed-ovoid, fairly conspicuous; ovary ovoid, about 0.2 cm long, very minutely pilosulose to glabrous; nectaries concrescent, essentially entire, about half equaling the ovary; follicles unknown.

Philippine Islands. LUZON, Cagayan Province, Raron, altitude 100 meters, *F. B. 26678 Peñas,* May 17, 1917 (BSM). MINDORO, data incomplete, *F. B. 11488 Merritt,* April and May, 1908 (US, isotype, MBG, photograph and analytical drawings).

12. KIBATALIA BLANCOI (Rolfe) Merr.

Kibatalia Blancoi (Rolfe) MERR., Philip. Journ. Sci. 17 (1920) 309.
Kickxia arborea F.-VILL., Nov. Append. (1880) 132; NAVES, in Blanco, Fl. Filip. ed. 3 (1877–83) *pl. 428 bis* non Blume.
Kickxia Blancoi ROLFE, Journ. Linn. Soc. Bot. 21 (1884) 313.

Trees; stems relatively stout, glabrous, rather obscurely lenticellate when fully mature; leaves oblong-elliptic, apex obtuse to very shortly and obtusely acuminate, base obtuse, 3 to 13 cm long, 1 to 4 cm broad, subcoriaceous, glabrous, or occasionally indefinitely puberulent-papillate beneath; petioles 0.2 to 0.5 cm long; inflorescence 1- to 4-flowered; peduncle scarcely manifest, glabrous; pedicels 1.3 to 1.7 cm long, glabrous; calyx lobes broadly ovate to ovate-subreniform, obtuse to rounded, 0.35 to 0.45 cm long, papillate without, the squamellæ alternate with the calyx lobes, lacerate and irregularly divided; corolla infundibuliform, white (according to Naves), the proper tube 0.6 to 0.8 cm long, about 0.4 cm in diameter at the base, abruptly constricted at the insertion of the stamens, glabrous within and

without, the throat cylindric-campanulate, 0.5 to 0.65 cm long, about 0.5 to 0.6 cm in diameter at the orifice, essentially glabrous without, minutely puberulent within, the lobes obliquely elliptic, acute to obtuse, 4 to 4.5 cm long, 1.2 to 1.4 cm broad, indefinitely papillate within and without; anthers included within the corolla throat, 0.6 to 0.7 cm long, minutely pilosulose towards the tip dorsally, the gland compressed-ovoid, relatively inconspicuous; ovary oblongoid, about 0.2 cm long, minutely puberulent; nectaries concrescent, obscurely lobed, nearly equaling the ovary; follicles unknown.

Philippine Islands. GUIMARAS, *F. B. 862 Gammill,* June, 1904 (BSM, NY, US, MBG, photograph). Data incomplete, *Loher 6329* (BSM, NY).

Also said to occur in Panay and Negros. The identity of this species rests essentially upon the plate in the third edition of Blanco's Flora de Filipinas, supplemented by Villar's short notes in the Novissima Appendix (1880) 132. The plate is an excellent one, corresponding exactly with the specimens from Guimaras Island collected by Gammill. Villar noted, as well, that specimens of the species represented by the plate referred to had been collected on Guimaras and at Igbaras, Iloilo Province, Panay. The identification of the plants cited above therefore appears secure.

Merrill's [9] interpretation of *K. Blancoi* is much broader than that adopted here, including *K. Merrittii, K. Macgregorii, K. Elmeri,* and *K. Merrilliana,* which are maintained as valid in this account of *Kibatalia.* My reasons for a more restricted interpretation are sufficiently outlined in the key to species immediately preceding. *Kibatalia Merrilliana* is particularly outstanding in the peculiar form of the nectary. Naturally field knowledge of the plants, impossible for me at present, is necessary for a surer interpretation of such closely related entities. Although authentic exsiccatæ of the four segregates of the inclusive *K. Blancoi* enumerated above were cited by Merrill,[10] it appears significant in the light of his interpretations that the specimens collected by Gammill and by Loher were not. The latter are the only specimens I have seen that exactly correspond to Naves's plate.

[9] Philip. Journ. Sci. 17 (1920) 309. [10] Loc. cit.

13. KIBATALIA PUBERULA Merr.

Kibatalia puberula MERR., Philip. Journ. Sci. 30 (1926) 423.

Small trees (according to Merrill); stems relatively stout, very minutely puberulent when young, soon becoming glabrate, inconspicuously lenticellate when fully mature; leaves broadly elliptic, apex very shortly and obtusely subcaudate-acuminate, base very broadly obtuse to rounded, 12 to 16 cm long, 5 to 9 cm broad, rather delicately membranaceous (subcoriaceous according to Merrill), glabrous above, very minutely and indefinitely puberulent beneath; petioles 0.3 to 0.4 cm long; inflorescence 1- to 3-flowered; peduncle about equaling the subtending petioles, essentially glabrous; pedicels about 2.5 cm long, very minutely and indefinitely puberulent; calyx lobes ovate-subreniform, obtuse, puberulent-papillate without, 0.3 to 0.4 cm long, the squamellæ alternate, solitary, minutely erose; corolla infundibuliform, white (according to Merrill), the proper tube 0.6 to 0.7 cm long, about 0.35 cm in diameter at the base, minutely papillate without, puberulent-papillate within, the throat cylindric, 0.8 to 1 cm long, about 0.45 cm in diameter at the orifice, minutely papillate without, puberulent within, the lobes oblanceolate-elliptic, broadly obtuse to rounded, 6 to 6.5 cm long, 0.8 to 1.2 cm broad, spreading, papillate within and without; anthers included within the corolla throat, or the tips barely exserted, 0.65 to 0.7 cm long, minutely and sparsely barbellate, the gland compressed, ovoid-subreniform, relatively conspicuous; ovary ovoid, about 0.15 cm long, essentially glabrous; nectaries concrescent, deeply 5-lobed, the margins ciliate, about half equaling the ovary; follicles unknown.

Philippine Islands. SAMAR, Loquilocon, overhanging streams, altitude 250 meters, *Bur. Sci. 43767 McGregor*, July, 1924 (NY, isotype, MBG, photograph and analytical drawings).

14. KIBATALIA ELMERI Woodson sp. nov.

Kibatalia Blancoi (Rolfe) MERR., Philip. Journ. Sci. 17 (1920) 309, as to specimens cited, in part.

Arborea ut dicitur 5–15 m attingens; ramulis crassiusculis glaberrimis maturitate sat inconspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice plerisque obtuse breviterque acuminatis basi obtuse acuteve cuneatis 4–12 cm longis, 1.5–3 cm latis coriaceis vel subcoriaceis omnino glaberrimis; petiolis 0.4–0.8 cm longis; inflorescentiis 1–3-floris; pe-

dunculo petiolos subbrevioribus; pedicellis 0.7–1 cm longis, glabriusculis; calycis laciniis late ovatis vel ovato-subreniformibus obtusis vel rotundatis, 0.35–0.5 cm longis extus papillatis squamellis alternatis solitariis rariusve geminis; corollae infundibuliformis ut dicitur albidae tubo proprio cylindrico-ampuliforme 1.5–1.8 cm longis basi 0.4–0.45 cm diametro metiente usque ad insertionem staminis gradatim angustato ibique ca. 0.2–0.25 cm diametro metiente extus glabro intus minute puberulo faucibus conico-campanulatis 0.7–0.8 cm longis ostio ca. 0.7–0.8 cm diametro metiente extus glabriusculis intus puberulis lobis oblique obovatis obtusis rotundatisve 4.5–5 cm longis 2–2.5 cm latis patulis intus extusque minute papillatis; antheris 0.6–0.65 cm longis in corollae faucibus inclusis dorso puberulis glandulo ovoideo valde manifesto; ovario oblongoideo ca. 0.2 cm longo glabriusculo; nectariis concrescentibus subintegris ovario subaequantibus; folliculis crassiusculis rigidis obtusis 12–17 cm longis ca. 1–1.5 cm diametro metientibus glabris divaricatis; seminibus ignotis.

Philippine Islands. LUZON, Irosin, Mount Bulusan, *Elmer 15934,* May, 1916 (BSM, MBG, type, NY, US), *Elmer 15270,* November, 1915 (BSM, MBG, cotype, NY, US): Laguna Province, Mount Maquiling, *F. B. 25726 Mabesa,* May, 1916 (BSM, US): Batangas Province, hillside near cogonal, *F. B. 21545 Tamesis,* May 18, 1910 (BSM): Ilocos Sur Province, hillside, *F. B. 25863 Adduru,* May 4, 1916 (BSM): Zambales Province, *Warburg 13775,* 1888 (BSM). MINDORO, Paluan, in deep forest, *Bur. Sci. 39812 Ramos,* March 29, 1921 (BSM, US). CATANDUANES, Colobon, Mount Taganasan, on top of ridge, *F. B. 28110 Mabbayag,* August 22, 1920 (BSM).

Popular names of this species are said to be "lancteng-gubat" (Tag.) and "cagpaayan" (Il.).

15. KIBATALIA MACGREGORII (Elm.) Woodson comb. nov.

Kickxia Macgregorii ELM., Leafl. Philip. Bot. 4 (1912) 1457.

Trees 8 to 10 m tall (according to collectors); stems relatively stout, glabrous, rather conspicuously (for the genus) lenticellate when fully mature; leaves oblong-elliptic, apex acutely to obtusely acuminate, base acutely to obtusely cuneate, 8 to 12 cm long, 1 to 3 cm broad, firmly membranaceous to subcoriaceous, glabrous throughout; petioles 0.3 to 0.7 cm long; inflorescence 1- or 2-flowered; peduncle scarcely manifest, glabrous; pedicels 1 to 1.5 cm long, glabrous; calyx lobes ovate, acute to obtuse, 0.3 to 0.35 cm long, minutely papillate without, the squamellæ

solitary, alternate with the calyx lobes; corolla infundibuliform, greenish white (according to Elmer), the proper tube cylindric, but little inflated at the base, 1.4 to 1.6 cm long, about 0.25 cm in diameter at the base, essentially glabrous without, minutely puberulent within, the throat subcylindric, 0.7 to 0.75 cm long, about 0.4 to 0.5 cm in diameter at the orifice, minutely papillate without, puberulent within, the lobes obliquely elliptic, acute, 3 to 3.2 cm long, 0.6 to 0.7 cm broad, very minutely and indefinitely papillate within and without, patulous; anthers essentially included within the corolla throat, 0.4 to 0.45 cm long, minutely barbellate; ovary ovoid-oblongoid, about 0.15 cm long, minutely and rather sparsely puberulent; nectaries concrescent, 5-lobed, about equaling the ovary; follicles unknown.

Philippine Islands. LUZON, Ilocos Sur Province, *F. B. 25465 Paraiso*, March 20, 1916 (BSM). SIBUYAN, Magallanes, Mount Giting-Giting, on the España side of the trail, near streamlets at 1,750 feet, *Elmer 12373*, April 1910 (MBG, NY, US, isotypes).

Possibly conspecific with *K. Elmeri*. With as many closely related entities occupying contiguous territory as the kibatalias in the Philippine Islands, one would suspect the possibility of hybridization, the bane of taxonomists. An indication of such a contingency may be the report by several collectors that the plants "are never known to fruit."

16. KIBATALIA MERRILLIANA Woodson sp. nov.

Arborea ut dicitur usque ad 10 m altitudine attingens; ramulis sat crassiusculis glaberrimis maturitate sat conspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice obtuse breviterque subcaudato-acuminatis basi obtuse cuneatis 7.5–14 cm longis, 2.5–4.5 cm latis, firme membranaceis subcoriaceisve omnino glaberrimis vel subtus indistinctissime papillatis; petiolis 0.4–0.5 cm longis; inflorescentiis 1–2-floris; pedunculo petiolis subbreviore glabro; pedicellis 2–2.5 cm longis glabris; calycis laciniis ovato-subreniformibus rotundatis 0.35–0.4 cm longis extus minute papillatis squamellis alternatis solitariis; corollae infundibuliformis ut dicitur albidae tubo proprio cylindrico-ampulliforme 2.5–2.7 cm longo basi ca. 0.8 cm diametro metiente deinde prope ostium gradatim angustato ostio ca. 0.35 cm diametro metiente extus glabriusculo intus minute puberulo faucibus campanulatis 0.7–0.8 cm longis ca. 0.7–0.8 cm diametro metientibus extus indistincte papillatis intus minute puberulis lobis oblique obovatis rotundatis 3.4–3.5 cm longis minute papillatis; antheris in faucibus corollae inclusis 0.6 cm longis gla-

briusculis; ovario oblongoideo ca. 0.3 cm longo minute sparseque pilosulo; nectariis concrescentibus funiformibus apice obscure 5-lobatis 0.5–0.55 cm longis delicate membranaceis minute puberulo-papillatis; folliculis ignotis.

Philippine Islands. LEYTE, Dagami, forest, altitude 60 meters, *Wenzel 330,* July 22, 1913 (BSM, US, type, MBG, photograph and analytical drawings).

This may be the specimen cited as *Wenzel 320* by Merrill [11] under the inclusive species *K. Blancoi.* In general habit it is somewhat similar to *K. Elmeri,* but upon dissection the flower is found to differ in the surprising development of the nectary.

17. KIBATALIA WIGMANI (Koord.) Merr.

Kibatalia Wigmani (Koord.) MERR., Philip. Journ. Sci. 17 (1920) 310 (where erroneously cited as *K. Wigmani* Koord.).
Kickxia Wigmani KOORD., Meded. s'Lands Plantent. 19 (1898) 528.

Trees 12 to 15 m tall; stems relatively slender, glabrous; leaves lanceolate to oblong-lanceolate, rarely oblong, apex shortly and acutely acuminate, base acutely cuneate, about 24 cm long and 6 cm broad, coriaceous, glabrous; petioles about 0.5 cm long; inflorescence 2-flowered; pedicels about 1.5 cm long; calyx lobes ovate, acute, about 1 cm long, essentially glabrous, the squamellæ numerous, indefinitely distributed, almost forming an erose ring; corolla infundibuliform, evidently white, the tube (sensu latiore) about 3.2 cm long, 1 to 1.1 cm in diameter at the orifice, glabrous without, villous within, the lobes oblong, about 7 cm long and 2.2 cm broad, spreading; anthers included, minutely puberulent dorsally; nectaries concrescent, obscurely 5-lobed, about equaling the ovary; follicles 28 to 29 cm long; seeds 3 to 3.4 cm long, the rostrum about 6 cm long, the coma about 6 cm long.

The description of this species from northeastern Celebes has had to be adapted from the original diagnosis by Koorders, as I have not been able to examine authentic specimens.

18. KIBATALIA ARBOREA (Blume) G. Don.

Kibatalia arborea (Blume) G. DON, Gen. Syst. 2 (1838) 86.
Hasseltia arborea BLUME, Bijdr. (1826) 1045.
Kixia arborea BLUME, Fl. Jav. Praef. 1 (1828) 7; A. DC. in DC., Prodr. 8 (1844) 408.
Kickxia arborea BLUME, Rumphia 4 (1848) 26, *pl. 179, fig. 1.*

[11] Philip. Journ. Sci. 17 (1920) 309.

Trees; stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves broadly ovate- to oblong-elliptic, apex broadly obtuse to very shortly and obtusely acuminate, base broadly obtuse to rounded, 11 to 25 cm long, 4.5 to 12 cm broad, membranaceous, glabrous above, very minutely and generally puberulent beneath; petioles 0.5 to 0.8 cm long; inflorescence 1- to 5-flowered; peduncle somewhat shorter than the subtending petioles; pedicels 3.5 to 4 cm long, glabrous; calyx lobes ovate to ovate-lanceolate, acute to acuminate, 0.5 to 0.6 cm long, minutely papillate to puberulent-papillate without, the squamellæ numerous, indefinitely distributed; corolla infundibuliform, evidently white, the proper tube narrowly flask-form, 1.2 to 1.8 cm long, about 0.35 cm in diameter at the base, gradually narrowing to 0.2 cm at the insertion of the stamens, minutely papillate to essentially glabrous without, minutely puberulent within, the throat campanulate to conical-campanulate, 1 to 1.3 cm long, 0.7 to 0.8 cm in diameter at the orifice, minutely papillate without, puberulent within, the lobes obliquely obovate, broadly obtuse to rounded, 3.5 to 3.8 cm long, minutely papillate, spreading; anthers essentially included within the corolla throat, 0.6 to 0.7 cm long, essentially glabrous dorsally; ovary ovoid-oblongoid, about 0.2 cm long, essentially glabrous; nectaries concrescent, 5-lobed, nearly equaling the ovary; follicles unknown.

JAVA, cultivated at Buitenzorg, date lacking, *Merrill s. n.* (NY, US); data incomplete, *Sargent s. n.* (MBG); *Kollmann s. n.* (NY).

EXCLUDED SPECIES

KIBATALIA AFRICANA (Benth.) Merr., Philip. Journ. Sci. 17 (1920) 309. *Kickxia africana* BENTH. in Hook., Ic. III 3 (1877–79) 59, *pl. 1276* = **Funtumia africana** (Benth.) STAPF in Hook., Ic. 27 (1901) *pls. 2696–2697.*

KIBATALIA ELASTICA (Preuss) Merr., Philip. Journ. Sci. 17 (1920) 309. *Kickxia elastica* PREUSS, Notizblatt 2 (1899) 353 = **Funtumia elastica** (Preuss) STAPF in Hook., Ic. Pl. 27 (1901) *pls. 2694–2695.*

KIBATALIA LATIFOLIA (Stapf) Merr., Philip. Journ. Sci. 17 (1920) 309. *Kickxia latifolia* STAPF, Kew Bull. (1898) 307 = **Funtumia latifolia** STAPF, in Hook., Ic. Pl. 27 (1901) *pls. 2694–2695.*

KIBATALIA SCHEFFERI (K. Sch.) Merr., Philip. Journ. Sci. 17 (1920) 309. *Kickxia Schefferi* K. SCH., Notizblatt 3 (1900) 81. Very similar to *F. africana*, according to Stapf, loc. cit.

KIBATALIA ZENKERI (K. Sch.) Merr., Philip. Journ. Sci. 17 (1920) 310. *Kickxia Zenkeri* K. SCH., Notizblatt 3 (1900) 81. Approaches *F. latifolia* very closely, according to Stapf, loc. cit.

THE IDENTITY AND AFFINITIES OF VALLARIS LANCIFOLIA HOOK. F.

Vallaris lancifolia Hook. f.[12] appears to be conspecific with neither *V. Pergulana* Burm., the type species of the genus, nor *V. Maingayi* Hook. f. with which it was originally associated by the younger Hooker. Of the two it most nearly resembles the latter in its erect habit, few-flowered lateral cymes, and anthers without the conspicuous dorsal gland characteristic of true *Vallaris*. Discrepancies with *V. Maingayi* [=*Kibatalia Maingayi* (Hook. f.) Woodson], however, are outstanding. The cymes of *V. lancifolia* are in opposite foliar axils, whereas those of all known species of *Kibatalia*, as well as of *Funtumia*, *Malouetia*, and *Forsteronia*, are alternate-axillary. The leaves of *V. lancifolia*, also, are not foveate in the axils of the midrib beneath. Two of the most generalized features of the foveate-leaved alliance of both Old and New World Echitoideæ are thus absent in *V. lancifolia*, with which it can scarcely be identified by several features of construction of the reproductive structures as well. The dorsal boss of the anthers of *V. lancifolia* is scarcely to be associated with the conspicuous staminal glands of *Vallaris* and *Kibatalia*, as believed by Hooker, since the former is apparently only a median contour of the connective proper, whereas the latter are definitely glandular hypertrophies of the filament.

Since *V. lancifolia* can scarcely be included within the neighboring genus *Pottsia* because of the salverform corolla, completely exserted stamens, fusiform style, and compound dichasial inflorescence of the latter, the most logical interpretation would apparently involve the establishment of a distinct genus:

Genus VALLARIOPSIS Woodson gen. nov. Apocynacearum (Echitoideæ)

Calyx profunde 5-partitus; laciniae scariaceae aequales margine imbricatae intus basi squamellas minutas plus minusve numerosas uniforme gerentes. Corolla speciei nostri subinfundibuliformis sat parva; tubus inferne cylindricus dein in fauces campanulatas viz bene manifestas dilatatus; limbi laciniae 5 aequales aestivatione dextrorsum convolutae. Stamina 5; antherae inter se adglutinatae et stigmati adplicatae anguste sagittatae dorso umbonem linearem gerentes basi angustissime 2-auriculatae dimidia parte superiore ventro pollinigerae apice exsertae, pollinibus granulosis; filamenta ligulata haud glandu-

[12] Fl. Brit. Ind. 3 (1882) 651.

ligera. Ovarii carpella gemina basi distincta apice in stylo filiforme producta, ovulis multis pluriseriatim superpositis; stigma capitato-fusiforme apice obscure 2-partitum. Nectarii glandulae 5 separatae vel basi paululo connatae. Folliculae ignotae. Frutices lactescentes epiphytici; folia opposita petiolata eglandulosa efoveolataque. Inflorescentia lateralis opposita subumbellata.

VALLARIOPSIS LANCIFOLIA (Hook. f.) Woodson comb. nov.

Vallaris lancifolia HOOK. F., Fl. Brit. Ind. 3 (1882) 651; KING and GAMBLE, Mat. Fl. Malay Pen. 4[3] (1907) 671.

Said to be an epiphytic shrub. The only specimen seen by me is the type (*Maingay 1048* in Hb. Kew; photograph and analytical drawings in Hb. Missouri Bot. Garden) from Malacca. Also reported from Penang and Perak by King and Gamble (loc. cit.).

ILLUSTRATION

PLATE 1

The foliar foveæ of certain genera of Echitoideæ; figs. 1 to 5, × 10; fig. 6, × 215.

FIG. 1. *Funtumia elastica* (Preuss) Stapf.
2. *Malouetia Schomburgki* Muell.-Arg.
3. *Forsteronia glabrescens* Muell.-Arg.
4. *Kibatalia Macgregorii* (Elmer) Woodson.
5. *Kibatalia microphylla* (Pitard) Woodson.
6. *Funtumia elastica* (Preuss) Stapf, transverse section.

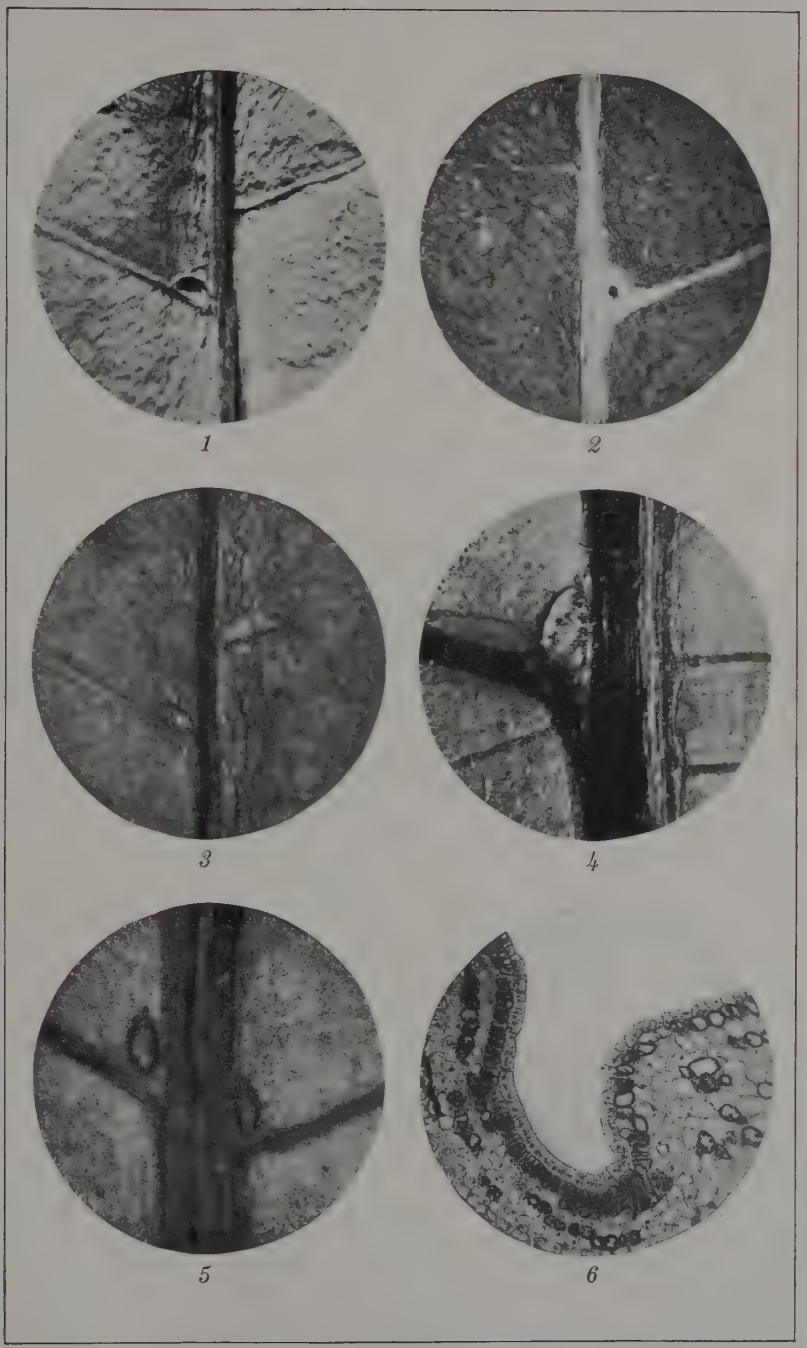

PLATE 1.

A NEW PHILIPPINE SPECIES OF CYCAS

By E. D. Merrill

Of the Gray Herbarium, Harvard University, Cambridge, Massachusetts

FOUR PLATES

February 11, 1902, I made a single day's trip inland from Halsey Harbor, Culion, the objective being a large open grassy area locally known as the *cogonal grande* or the *patag grande* originally selected as a possible site for the Culion leper colony. Towards the northern part of this area my attention was called to a number of characteristic *Cycas* plants, these mostly 1 to 2 m high, growing on open gentle slopes in the cogon (*Imperata*) area. A number of these were examined, but none of the plants bore traces of either male cones or female sporophylls. I accordingly had to content myself with collecting a few leaves. Until 1923 this single collection represented all that was known regarding this cycad.

In the early part of 1908 I compared the Kew specimen of my No. 657 with the *Cycas* material in that herbarium, concluding that the only close match was the Australian *Cycas cairnsiana* F. Muell. In my Enumeration [1] I placed this number under F. Mueller's species with the comment: "A curious species, of which only the leaves are known, perhaps representing the above Australian species."

Although several attempts were made by correspondents and friends to locate this *Cycas* in Culion it was not until April, 1923, that additional material came in when Dr. G. A. Perkins and Dr. H. W. Wade found the species near where I had originally collected it, and sent portions of a single leaf and a few male sporophylls to Manila. Previous trips made by Doctors Perkins and Wade had failed in their objectives, probably for the reason that my trip was made eastward from Halsey Harbor on the west coast of the island, and their trips were made westward from the Culion Leper Colony on the east coast. On the trip in April, 1923, which resulted in the relocation of the species, the plants were found late in the afternoon after Doctors Wade and Perkins had been on the trail for about seven hours. Later

[1] Enum. Philip. Fl. Pl. 1 (1922) 1.

abundant material with staminate cones, female sporophylls, and mature fruits was collected by Dr. W. H. Brown. At the same time Doctor Wade transplanted some of the mature cycads to the Culion Leper Colony, two of which were taken to Manila and established on the Bureau of Science grounds. In April, 1931, leaves with female sporophylls and fruits were collected by Dr. A. W. Herre in Culion. It was the receipt of this last collection for identification that reminded me of the unsolved problems associated with this interesting cycad, which lead me to communicate with Dr. W. H. Brown, asking for the loan of the available material that would enable me to prepare a reasonably complete description. In the meantime, however, J. Schuster [2] had attached a cumbersome quadrinomial to this Culion species on the basis of the original sterile collection, calling it *Cycas circinnalis* Linn. subsp. *riuminiana* (Porte) var. *curranii* Schuster, forma *graminea* Schuster. Complete material clearly shows that Doctor Schuster was as far from the true alliances of this Culion cycad in sinking it in *Cycas circinnalis* Linn., which he treats as a collective species, as I was in referring it to *C. cairnsiana* F. Muell.; both of these belong in the section *Lemuricæ,* while the Culion plant actually belongs in the section *Indosinenses,* in the alliance with *Cycas inermis* Lour. With his apparently broad concept of specific limits Doctor Schuster doubtless would have made this a form, variety, or subspecies of *Cycas siamensis* Miq. under which he placed *C. inermis* Lour. as a subspecies. After a careful consideration of all factors I prefer to consider the Culion plant as worthy of specific rank and accordingly supply the following technical description. In describing this as *Cycas Wadei* I would explain that the specific name is selected to commemorate the services of Dr. H. Windsor Wade, for many years in charge of research at the Culion Leper Colony, to whom we are indebted for much of our information regarding the plant, as well as for photographs, mature fruits and other botanical material, and maximum and minimum measurements of various plants as they occur in nature.

CYCAS WADEI sp. nov. § Indo-sinenses.

Cycas circinnalis Linn. subsp. *riuminiana* Schuster var. *curranii* Schuster forma *graminea* SCHUSTER in Pflanzenreich 99 (IV–1) (1932) 69.

Cycas sp. FOXW. in Philip. Journ. Sci. 6 (1911) Bot. 151.

Cycas cairnsiana MERR., Enum. Philip. Fl. Pl. 1 (1922) 1, non F. Muell.

[2] Cycadeae, Pflanzenreich 99 (IV–1) (1932) 69.

Truncis usque ad 5.3 m altis, plerumque multo brevioris, basi incrassatis, 30–40 cm diametro, sursum reductis, infra foliis 10–20 cm diametro; foliis numerosis, circiter 25 cm longis, petiolo breviter spinoso, foliolis utrinque circiter 90, confertis, crassis, rigidis, acute acuminatis, lineari-lanceolatis, rectis vel leviter falcatis, planis, 4–5 mm latis, medianis 15–20 cm longis, inferioribus brevioribus, infimis 8 cm longis; strobilis ♂ cylindraceis, 40–55 cm diametro, sursum angustatis, microsporophyllis numerosissimis, confertis, sphenoideis, medianis circiter 3 cm longis, deorsum valde angustatis, sursum triangularis, basi acutis, apice truncatis, 1.5–2 cm latis, in acuminis tenuibus fragilibus sursum arrectis 5–6 mm longis productis, obscure 5-dentatis vel breviter 5–lobatis; megasporophyllis ferrugineo-tomentosis, usque ad 22 cm longis, pedunculis circiter 15 cm longis et 1 cm latis, megasporangiis 1–3 gerentibus, laminis terminalibus sterilis in ambitu ovatis, circiter 10 cm longis, 7 cm latis, ferrugineo-pubescentibus, longe acuminatis, pectinato-pinnatifidis, lobis utrinque circiter 15, linearis, acute acuminatis, sursum glabris, usque ad 3.5 cm longis; fructibus ellipsoideis vel ovoideis, rotundatis, 3.2–4 cm longis, 2.5–3 cm diametro, putamine longitudinaliter distincte 9-15-costatum.

Trunk [3] up to 5.3 m high, usually much shorter, and in many mature plants less than 1 m high, often branched, base swollen, usually tapering above, varying in diameter from 30 to 48 cm at the base and from 10 to 20 cm below the crown of leaves, the swollen base tapering rather abruptly in the lower 20 to 45 cm, and much more gradually above. Leaves numerous in the terminal crown, crowded, about 75 cm long, 25 to 30 cm wide, the petiolar part about 20 cm long and with two rows of short spines in positions corresponding to the attachment of the leaflets, but with no transition from leaflets to spines, these spines acute, about 1.5 mm long, spaced on the average about 6 mm apart, the petiole 5 to 10 mm in diameter, the rachis rounded and smooth on the lower surface, the upper surface blunt-angled, the sloping sides and basal parts of the leaflets on the upper surface in young leaves cinnamomeous-pilose, in age entirely

[3] A striking character of the trunk is the presence of pronounced rings around it, which are plainly shown in a number of the illustrations. A male plant growing in the grounds of the Bureau of Science branched and rebranched until it had a number of heads, and each head produced a cone. Gradually most of the heads died out and eventually there were four left as is shown in the illustration. There was nothing to indicate that this branching was due to injury or any other abnormal circumstance.

glabrous. Leaflets rather close, about 90 on each side of the rachis, linear to linear-lanceolate, coriaceous, rigid, straight or somewhat falcate, spaced at about the rate of 9 on each side within a distance of 5 cm, flat, not at all revolute, smooth, sharply acuminate, base slightly narrowed, 4 to 5 mm wide, the median ones 15 to 20 cm long, the lowest ones but 8 cm long, but with no transition into petiolar spines, the uppermost ones again shorter, about 8 cm long; male cones cylindric, somewhat narrowed below, more strongly tapering upward, 40 to 70 cm long, 9 to 10 cm in diameter, the microsporophylls very numerous, crowded, the median ones about 3 cm long, the claw rather narrow, the somewhat rhomboid limb 1.5 to 2 cm wide, tapering below, the apex truncate, the lower surface of both claw and limb covered with microsporangia, the upper surface of the limb glabrous, the exposed sterile end puberulent, about 2 cm wide and 1 cm high, ascending at about a right angle, the tip thin, ovate from the broad base, 5 to 6 mm long and wide, rounded to acute or to somewhat acuminate, not conspicuous, with usually 3 to 5 slender teeth or short narrow lobes, sometimes nearly entire. Megasporophylls up to 22 cm long, rather densely ferruginous-pilose, the peduncular part about 15 cm long, 1 cm wide, bearing few, usually but two, megasporangia, the sterile limb ovate in outline, up to 10 cm long and 8 cm wide, pectinate-pinnatifid, the lobes about 15 on each side, usually ascending, linear, rather rigid, sharp-pointed, pubescent below, glabrous above, or entirely glabrous, up to 3.5 cm long, the tips of the sterile limbs usually long-acuminate, with few, gradually shorter, ascending lobes or the uppermost ones often reduced to teeth only 1 to 2 mm long. Fruits ovoid to ellipsoid, sessile, not at all compressed, brown, glabrous, shining, somewhat rugose when dry, apex rounded, rarely obscurely and minutely apiculate, 3.2 to 4 cm long, 2.5 to 3 cm in diameter. Seeds conforming to the fruit in shape, the putamen woody, pale, somewhat shining, longitudinally 9- to 15-ribbed.

CULION, Cogonal Grande or Patag Grande, *Merrill 657*, February 11, 1902, a sterile specimen, type of forma *graminea* Schuster of *Cycas circinnalis* Linn. subsp. *riuminiana* Schuster var. *curranii* Schuster; *H. W. Wade and G. A. Perkins*, April 4, 1923, with staminate sporophylls; *A. W. Herre 1061*, April 27, 1931; and abundant material secured by W. H. Brown, the type collection.

Mature plants of this interesting *Cycas* are now in cultivation at the Culion Leper Colony and in the grounds of the Bureau of Science, Manila, while seedlings are in cultivation at the New York Botanical Garden and the Coconut Grove Palmetum in Florida; viable seeds were transmitted to the Royal Botanic Gardens at Kew and to the Botanical Garden at Berlin.

Striking characters of the present species are found in its unusually narrow leaflets and in its distinctly ribbed putamen. In *Cycas circinnalis* and its allied species the putamen is very smooth; it is perhaps ribbed in some of the *Indosinenses* species, but I have no data on this point.

302523——3

ILLUSTRATIONS

PLATE 1. CYCAS WADEI MERRILL

FIG. 1. Male plant grown naturally in Culion, with two cones indicating two heads.
2. Branched specimen growing naturally in Culion.

PLATE 2. CYCAS WADEI MERRILL

FIG. 1. Male plant grown in the Bureau of Science grounds. The main trunk has four heads.
2. Female plant grown in the Bureau of Science grounds, Manila.

PLATE 3. CYCAS WADEI MERRILL

FIG. 1. Male cones.
2. The young "cone" of megasporophylls.
3. Crown of a female plant showing megasporophylls and juvenile leaves.
4. Crown showing leaf bases and megasporophylls.

PLATE 4. CYCAS WADEI MERRILL

FIG. 1. Male cone.
2. Longitudinal section of a male cone.
3. Megasporophyll with an ovule.
4. Ovules.
5. Seeds showing ribbed putamen.

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PLATE 1.

1

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PLATE 2.

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PLATE 3.

PLATE 4.

EFFECT OF MOLDS ON BAKAUAN BARK AND TANNING LIQUORS

By F. M. Yenko, Luz Baens, and F. B. Serrano[1]

Of the Bureau of Science, Manila

THREE PLATES

The tannin-extract industry in the Philippines produces annually about 5,500,000 kilos of solid extract with an estimated value of about 500,000 pesos.[2]

Practically all of this extract comes from bakauan bark (*Rhizophora* spp.) and is known commercially as cutch (super) extract. The mangrove swamps which yield most of these barks are estimated to cover an area of approximately 320,789 hectares.

In the process of cutch manufacture the time that elapses from the felling of the tree and the stripping of the bark to the first leaching ranges from two to four weeks or more. During the transportation by water from the swamps to the cutch factory the barks, which are piled in the hold of the ship, generate heat and exude moisture. Under these conditions the barks usually become infected with molds.

Knudson's[3] experiments showed that in 10 per cent tannic acid solutions only *Aspergillus flavus*, *Aspergillus niger*, and *Penicillium* sp. were able to grow. Seltzer and Marshall,[4] in their investigation on the loss of tannin from liquors prepared from different tanning materials, used the solid mangrove-bark extract, but they did not state the specific organism causing the loss of tannin.

The object of this investigation was to determine the effect of molds on the tannin content of both the bakauan bark and the cutch solution obtained from it.

The bakauan bark used in this investigation was obtained from a mangrove swamp near Zamboanga through the courtesy

[1] In this investigation the chemical work was done by F. M. Yenko and Luz Baens. The histological study was carried out by F. B. Serrano.

[2] Annual Report of the Insular Collector of Customs, Manila (1934) 274.

[3] Journ. Biol. Chem. 14 (1913) 159.

[4] Journ. Am. Leather Chem. Assoc. 25 (1930) 168.

of the Philippine Cutch Corporation. The bark, immediately after stripping, was dried at 60° C. to expel moisture and then shipped directly to Manila. When it was received in the laboratory, there was no evidence of molds on the bark.

The molds were taken from a large shipment of bark received from Palawan.

The first step in our studies was the isolation and identification of the molds. Only two kinds were isolated and they were identified by descriptions and characteristics recorded in the literature as *Aspergillus niger* Van Tieghem and *Penicillium glaucum* Link.

A description of *A. niger* Van Tieghem is given by Thom and Church [5] as follows:

Stalks smooth; heads in varying shades of fuscous, purplish brown to carbon black; conidia rough or tuberculate from bars or tubercles of brown or purplish brown coloring substance.

The *Aspergillus niger* group, as described by Van Tieghem, is characterized by rapidly growing colonies with abundant submerged colorless mycelium. In some strains, however, yellow color may be found in the hyphæ and in the substratum. Aërial hyphæ are usually scantily produced, but are abundant in age in certain strains.

Aspergillus niger, therefore, is used to designate a whole group of black aspergilli with fundamental characters in common, within which *A. niger* Van Tieghem becomes the typical species of a section falling approximately within the range of detailed characters established by Van Tieghem for the strain used in his fermentation studies.

The following description of *Penicillium glaucum* Link is given by Thom: [6]

Colonies green with a yellow tinge, surface coarse and rough, dense mycelium, spreading slowly, without wrinkles; odor intensely moldy with a suggestion of naphtha, suggestive of rotten oranges, taste of mold in cheese bitter, obnoxious; grows best between 15° and 25° C., poorly above 25° C., and not above 30° C.; liquefies beer wort gelatine in five days at 15° C.; grows fairly well under partly anaërobic conditions where it produces white perithecia in four days without green conidial areas; dissolves casein.

[5] The Aspergilli (1926) 167. [6] The Penicillia (1930) 561.

EXPERIMENTAL PROCEDURE

Aspergillus niger.—The effect of *A. niger* on the tannin content of bakauan bark was determined in the following manner: Pieces of fresh bark, immediately after stripping from the tree, were carefully dried at 60° C. They were then inoculated with spores and placed in a container that allowed the barks to regain their original moisture content. The barks remained in this condition during the period of mold growth.

A representative sample of the fresh bark was analyzed for its original tannin content. The inoculated bark was also analyzed after sixteen weeks of mold growth. Results of the analysis are given in Table 1.

It has been shown that tannic acid is toxic to a large number of fungi at relatively low concentrations.[7] Table 1 shows a marked reduction in the percentage of nontans after inoculation and growth of *A. niger* on bakauan bark. The tannin content, however, was lowered by only 5.15 per cent after a period of four months' growth. The purity increased in spite of a lowering in the tannin content. The results further show a marked reduction in the soluble solids. Even if the tannin content does not appear to be very much affected, the amount of extract that can be obtained from a given weight of bark, will be reduced when *A. niger* grows on it.

To observe the effect of *Aspergillus niger* on bakauan-cutch solution, two solutions of different strengths (2 and 5 per cent tannin content) were prepared and heated on a steam bath for thirty minutes to pasteurize. Two-liter portions of each were separately inoculated with spores of *A. niger*. The tannin content of the solutions was determined before inoculation and periodic analyses were made afterwards.

In selecting aliquot portions of the solutions for analysis, the flasks were rotated gently between the hands in order to get average samples, and care was taken to avoid disturbance of the mold growth on the surface. Evaporation losses were made up with distilled water before samples were taken for analysis. The results are recorded in Tables 2 and 3.

Table 2 shows the effect of *A. niger* on a solution containing 2 per cent tannin. In this solution the mold grew very abundantly. After nine and a half months' growth there was a final

[7] Knudson, L., Journ. Biol. Chem. 14 (1913) 164.

reduction in the tannin content of 27.62 per cent. Most of this reduction appeared to take place after seven months' growth. The insoluble solids increased and the nontans decreased. In this case there was also an appreciable increase in purity.

Although *A. niger* grew abundantly in a tannin concentration of 5 per cent it lowered the original tannin content of the solution by only 1.62 per cent after eleven months' growth as shown in Table 3. There was a slight reduction of nontans and soluble solids and an increase in purity. Apparently the higher concentration of bakauan-cutch solution is not easily deteriorated by the *A. niger* mold. When the same mold grows in a tannin solution of lower concentration, the changes in the solution are more pronounced.

Penicillium glaucum.—In studying the effect of the mold *P. glaucum* on cutch solutions obtained from bakauan bark the experimental procedure employed was the same as that used for studying the effect of the mold *A. niger*. Cutch solutions prepared from the bark were inoculated with spores, and analyzed periodically. The results of the analysis are given in Table 4.

Penicillium glaucum is not as strong a fermentative organism as *A. niger*, for it failed to grow in a cutch solution containing 5 per cent tannin, in which the latter thrived well. In a lower concentration (2 per cent) *P. glaucum* grew abundantly.

The first evidence of deterioration of the 2 per cent solution was the decrease in the percentage of nontans and soluble solids. After nine and a half months' growth in this solution, *P. glaucum* effected a reduction of 32.38 per cent in the original tannin content. At the beginning of the experiment purity gradually increased, but at the end the purity percentage was almost the same as the original.

All of these results show that the deterioration of bakauan bark is not easily effected by the two molds that have been found to attack tannin in its more concentrated solutions. It is also apparent that *A. niger* is a much more active organism than *P. glaucum*. When *A. niger* grows on bakauan bark, there is always a possibility that there will be some loss in the yield of extract.

To determine the possible changes in the color of the leather tanned with solutions infected with these molds, sheepskin skivers were tanned with solutions having a concentration of 0.4 per cent tannin for each mold. The colors of the leathers

obtained were compared with Ridgway's [8] color standards as shown below.

Kind of solution.	Color of skiver.
Bakauan-cutch solution obtained from Philippine Cutch Corporation. (Standard solution containing no molds.)	Light reddish cinnamon to reddish cinnamon.
Extract of bakauan bark infected with *A. niger.* (Bark with 4 months' mold growth.)	Light reddish cinnamon.
Bakauan-cutch solution infected with *A. niger.* (Solution with 9.5 months' mold growth.)	Brownish yellow to dull brick red.
Bakauan-cutch solution infected with *P. glaucum.* (Solution with 9.5 months' mold growth.)	Reddish brown.

Skins tanned with standard cutch solution gave very nearly the same results as those tanned with extract of bakauan bark infected with *A. niger* (4 months' mold growth).

When the skins were tanned with bakauan-cutch solutions containing *A. niger* or *P. glaucum* (9.5 months' mold growth) the color of the leather was somewhat different from the color obtained by tanning with standard cutch solution.

HISTOLOGICAL STUDY OF THE DETERIORATION OF BAKAUAN BARK DUE TO MOLDS

To observe further the effect of the growth of *A. niger* on bakauan bark and to study the extent to which this mold embeds itself in the bark and deteriorates the tissues, the following histological studies were made.

Both normal and moldy bakauan barks were cut into cubic blocks having sides about 1 centimeter in length. The blocks were boiled separately in tap water for an hour to expel air bubbles and then soaked in concentrated hydrofluoric acid for softening purposes. Vials coated inside with paraffin were used as containers. A month later the blocks were soft enough to section. They were removed from the acid, washed in running water for two days, dehydrated through a series of alcohol treatments, cleared in xylol, mounted in paraffin, and then cut with a rotary microtome into serial sections having a thickness of 5 microns. With Mayer's albumen fixative the sections were mounted securely on clean glass slides, cleared of paraffin by dipping in xylol for a minute or two, washed several times with

[8] Color Standards and Color Nomenclature. Washington (1912).

alcohol, and stained with a combination of Bismarck brown and methyl violet. After the necessary dehydration and clearing, the sections were finally mounted in Canada balsam.

Microscopical examinations of these microtome sections showed the cells (Plate 1) of the normal bark to be rigid and compact in contrast to the disintegrated cells (Plate 2) of the moldy bark. Staining with a combination of Bismarck brown and methyl violet rendered the mycelial threads of the mold *A. niger* a deep violet color that distinguished them from the bark tissues which had a light violet to a brownish yellow color (Plate 3).

As shown by the microphotographs the fungus hyphæ usually follow the latex tubes. This indicates that the mold attack is directed mainly against the latex and only partly against the cell walls. Perhaps the starch, sugar, and magnesium salts contained in the latex serve as the principal attraction for the molds. The molds apparently affect the binding materials in the cells and thus the infected tissues are disintegrated. The antiseptic property of the tannin in the latex is evidently not sufficiently potent to retard the mold growth. These observations are in agreement with the results obtained from the chemical tests.

SUMMARY

The two molds *Aspergillus niger* and *Penicillium glaucum* were the only ones found growing on Philippine bakauan bark.

The mold *A. niger* was found to disintegrate the tissues of bakauan bark, but it did not seem to affect materially the composition of the extract obtained from it.

Tanning extracts were made from bakauan bark, infected with the mold *A. niger*, and also from bark that was not moldy. These different extracts gave leathers of about the same color.

Bakauan extract containing 5 per cent tannin is not attacked by the mold *P. glaucum* and is only slightly affected by *A. niger*.

Dilute bakauan extracts containing 2 per cent tannin are attacked by the molds *A. niger* and *P. glaucum* only after prolonged exposure.

The growth of hyphæ along the latex tubes indicates that the mold attack is directed mainly against the latex and only partly against the cell walls. These observations are in agreement with the results obtained from the chemical tests.

TABLE 1.—*Analyses of normal bakauan bark and bakauan bark inoculated with Aspergillus niger.*

Date of analysis.	Tannin.	Non-tannin.	Purity.[c]	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
October 31, 1935 [a]	33.99	13.37	71.77	----------	54.26	47.36	6.90
March 4, 1935 [b]	32.24	11.10	74.39	—5.15	53.28	43.34	9.94

[a] Before inoculation.

[b] After inoculation.

[c] The purity is obtained by dividing the percentage tannins by the percentage soluble solids and multiplying the result by 100.

TABLE 2.—*Analyses of bakauan-cutch solution inoculated with Aspergillus niger.*

Date of analysis.	Tannin.	Non-tannin.	Purity.	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
October 29, 1934 [a]	2.10	0.81	72.16	----------	2.94	2.91	0.03
November 22, 1934 [b]	2.26	0.64	77.93	+ 7.62	2.94	2.90	0.04
January 9, 1935 [b]	2.25	0.50	81.82	+ 7.14	2.80	2.75	0.05
February 19, 1935 [b]	2.24	0.52	81.16	+ 6.67	2.78	2.76	0.02
June 17, 1935 [b]	2.04	0.48	80.95	— 2.86	2.57	2.52	0.05
August 12, 1935 [b]	1.52	0.40	79.17	—27.62	2.07	1.92	0.15

[a] Before inoculation. [b] After inoculation.

TABLE 3.—*Analyses of bakauan-cutch solution inoculated with Aspergillus niger.*

Date of analysis.	Tannin.	Non-tannin.	Purity.	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
September 10, 1934 [a]	4.95	1.56	76.04	----------	6.63	6.51	0.12
September 18, 1934 [b]	5.07	1.52	76.93	+2.42	6.69	6.59	0.10
September 26, 1934 [b]	5.02	1.56	76.29	+1.41	6.63	6.58	0.05
October 18, 1934 [b]	4.99	1.12	81.67	+0.81	6.18	6.11	0.07
October 24, 1934 [b]	5.04	1.36	78.75	+1 82	6.41	6.40	0.01
November 7, 1934 [b]	5.11	1.30	79.72	+3.23	6.45	6.41	0.04
December 5, 1934 [b]	5.08	1.25	80.25	+2.63	6.39	6.33	0.06
February 19, 1935 [b]	5.13	1.02	83.41	+3.64	6.29	6.15	0.14
April 4, 1935 [b]	5.21	1.09	82.70	+5.25	6.33	6.30	0.03
June 17, 1935 [b]	5.01	1.18	80.94	+1.22	6.32	6.19	0.13
August 12, 1935 [b]	4.87	1.10	81.58	—1.62	6.21	5.97	0.24

[a] Before inoculation. [b] After inoculation.

TABLE 4.—*Analyses of bakauan-cutch solution inoculated with Penicillium glaucum.*

Date of analysis.	Tannin.	Non-tannin.	Purity.	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
October 29, 1934 [a]	2.10	0.81	72.16	----------	2.94	2.91	0.03
November 22, 1934 [b]	2.31	0.58	79.93	+10.00	2.93	2.89	0.04
January 9, 1935 [b]	2.26	0.59	79.30	+ 7.62	2.85	2.85	0.00
February 19, 1935 [b]	2.26	0.54	80.71	+ 7.62	2.86	2.80	0.06
June 17, 1935 [b]	1.84	0.78	70.23	—12.38	2.68	2.62	0.06
June 26, 1935 [b]	1.62	0.99	62.07	—22.86	2.74	2.61	0.13
August 12, 1935 [b]	1.42	0.56	71.72	—32.38	2.28	1.98	0.30

[a] Before inoculation. [b] After inoculation.

ILLUSTRATIONS

[All the microscopic sections were stained with a combination of Bismarck brown and methyl violet.]

PLATE 1

FIG. 1. Longitudinal section of normal bakauan bark (*Rhizophora* spp.) showing rigidity and compactness of cells.

2. Cross section of normal bakauan bark showing the same rigidity and compactness of cells as illustrated in the longitudinal section.

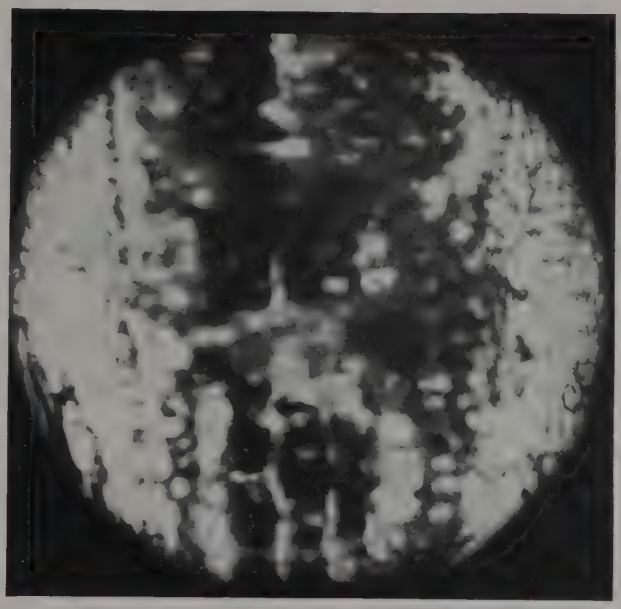
PLATE 2

FIG. 1. Longitudinal section of bakauan bark infested by the mold *Aspergillus niger*. The section shows disintegration of cells due to mold action.

2. Cross section of bakauan bark infested by the mold *A. niger*. Disintegration of cells by mold action is even more pronounced than in the longitudinal section of the infested bark.

PLATE 3

Longitudinal section (fig. 1.) and cross section (fig. 2.) of bakauan bark infested with the mold *A. niger*. These sections are more highly magnified than those represented in Plate 2. They show fungus mycelia represented by dark filamentous and branched structures. The fungus filaments are deep violet, while the bark tissues are brownish yellow to light violet.



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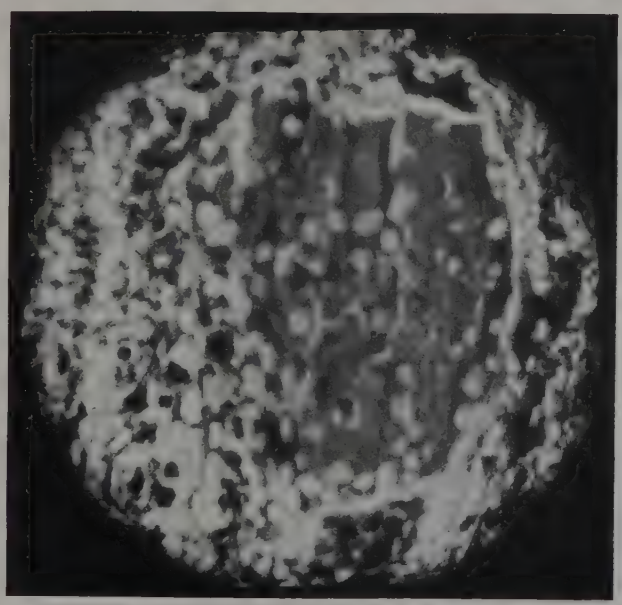

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PLATE 1.

1

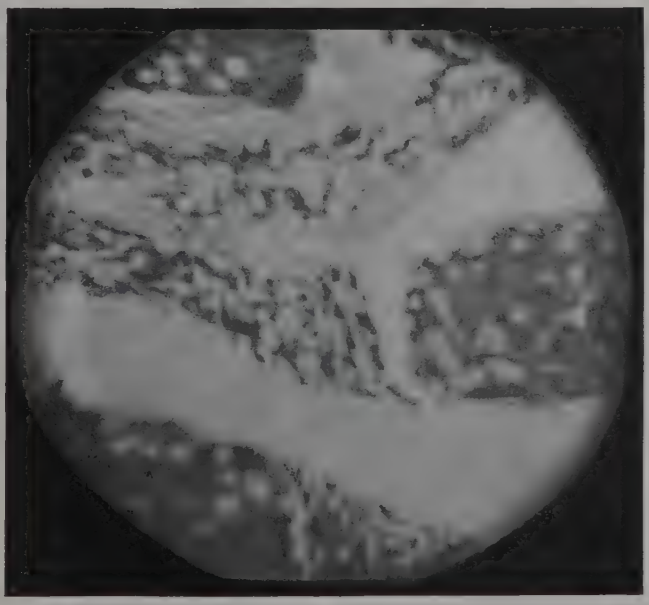

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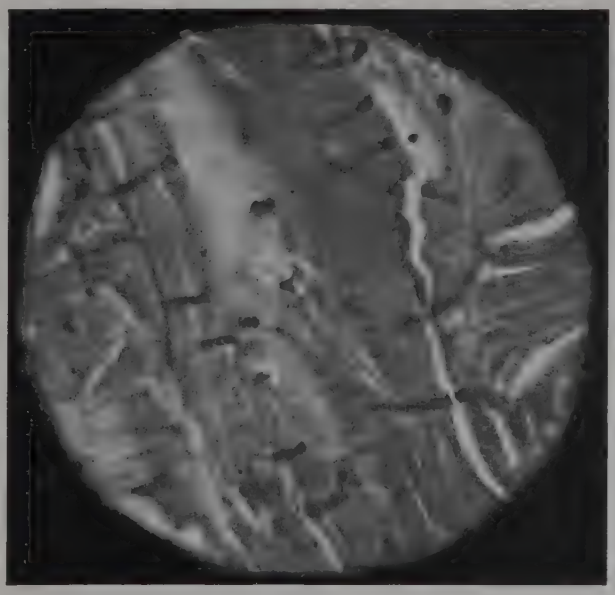
PLATE 2.



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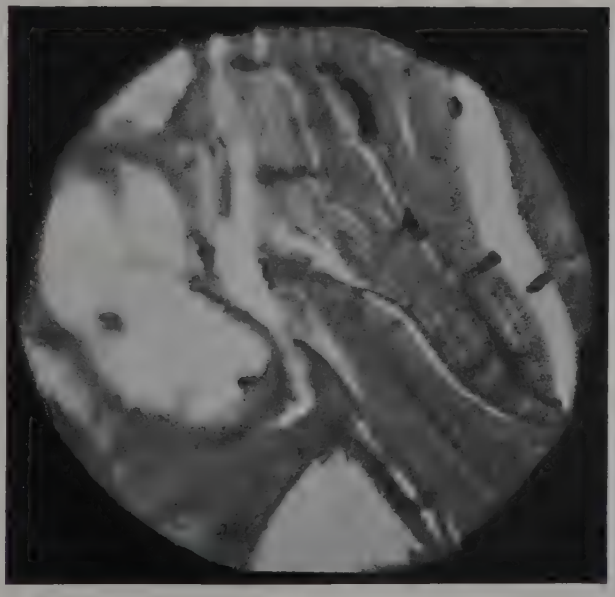

2

PLATE 3.

THE INTERRELATIONS OF COMPRESSIBILITY, MELTING POINT, SOLUBILITY, VALENCE, AND OTHER PROPERTIES OF THE HALIDES OF THE ALKALI AND ALKALINE EARTHS.[1]

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From already known data(1) it seems possible to represent by simple formulas the relations between constants, which have been hitherto expressed in a more or less complicated manner.

The compressibilities of some halides, for instance, can be calculated from the equation

$$K=\frac{V_2}{5.6\times 10^{12}Z} \qquad (1)$$

where K is the compressibility; V_2, molecular volume of the solid; and Z, valence. Born(3) calculates his values from the heats of ionization and formation and other properties. Table 1 shows Born's values and Table 2, those calculated from equation 1.

In passing it may be mentioned that 5.6×10^{12} (instead of 1.33×10^{5}) would be the value of the constant used in an equation given in a previous work,(2) if the heat of formation is given in ergs. The equation referred to is

$$H=1.33\times 10^{5}Z\sqrt[3]{\triangle V} \qquad (2)$$

where H is the heat of formation in calories; $\triangle V$, shrinkage in volume per unit volume incident to compound formation; and Z, valence.

Hildebrand's(5) comparison of calculated and observed values of solubility is given in Table 3. However, using a simple relation

$$Sn=\frac{(5.7-P)^3}{10} \qquad (3)$$

gives solubilities, Sn, that are closer to observed values. P is the electrolytic decomposition potential. It may be mentioned that 5.7 is the constant used by the writer(2) in relating the volume shrinkage with the electrolytic decomposition potential as follows:

$$P=5.7\sqrt[3]{\triangle V} \qquad (4)$$

[1] Read before the Third Philippine Science Convention, February 26, 1935.

Fajans,(4) in pointing out the relation of melting point to the size of molecules, offers the comparison shown in Table 5. Table 6 is the comparison based on volume shrinkage, the equation being

$$Tm = 15 \times 10^2 \sqrt[3]{\triangle V} \qquad (5)$$

where Tm is the melting point. This constant may also be calculated from the heat of formation thus:

$$Tm = \frac{1.13 \times 10^{-2} H}{Z} \qquad (6)$$

The values calculated from this are given in Table 7.

Another simple relation, obtained by combining equations 2 and 4, is

$$H = 2.333 \times 10^4 ZP \qquad (7)$$

Results from this equation are given in Table 8.

TABLE 1.—*Compressibility calculated by Max Born, as estimated from his graph.*

	Calculated.	Observed.
NaCl	3.4×10^{-12}	4.2×10^{-12}
NaBr	4.7	5.1
NaI	6.3	7.1
KCl	5.3	5.7
KBr	6.6	6.7
KI	8.7	8.6
TlCl	4.8	4.8
TlBr	5.3	5.1
TlI	6.8	6.7

TABLE 2.—*Compressibility as calculated from molecular volume (equation 1).*

	$\frac{V_2}{Z}$	Calculated.	Observed.
LiF	9.97	1.8×10^{-12}	1.5×10^{-12}
LiCl	20.51	3.6	3.5
LiBr	25.21	4.5	4.3
LiI	32.95	5.9	[a] 5.9
NaF	15.18	2.7	[a] 2.07
NaCl	26.96	4.8	4.2
NaBr	34.14	6.1	5.1
NaI	40.66	7.3	7.1
KF	23.43	4.2	3.3
KCl	37.43	6.7	5.7
KBr	43.28	7.7	6.7
RbCl	43.09	7.7	7.4
$CaCl_2$	25.79	4.6	4.4
$CaBr_2$	29.81	5.3	4.8

[a] P. W. Bridgman, Proc. Am. Acad. Arts and Sci. 67 (1932) 345–375.

TABLE 3.—*Solubility in Mol fraction as calculated by Hildebrand compared with observed values.*

	Calculated.	Observed.
$AgNO_3$	26×10^{-2}	16×10^{-2}
$NaClO_3$	8	15
HgI_2	11	0.0002
KNO_3	21	6.3
$NaNO_3$	10	16
$K_2Cr_2O_7$	18	18
AgCl	13	0.00002
$PbCl_2$	6	0.067
KCl	1	8.8

TABLE 4.—*Solubility in grams per cubic centimeters as calculated from equation 4.*

Solute.	Calculated.	Observed.
LiF	0.05	0.0027
NaCl	0.4	0.36
NaBr	0.7	0.80
NaI	1.6	1.6
KCl	0.3	0.29
KBr	0.5	0.53
$CaCl_2$	0.6	0.60
CaI_2	2.0	1.92
$SrCl_2$	0.4	0.44
$BaCl_2$	0.3	0.31

TABLE 5.—*Fajan's indication of parallelism of size with melting and boiling points.*

	NaF	CaO
Lattice distance	2.31 A	2.38 A
Melting point	997°	2,572°
Boiling point	1,695°	2,850°

TABLE 6.—*Relation between volume shrinkage $\triangle V$ and melting point (equation 6).*

		Tm	
	$\sqrt[3]{\triangle V}$	Calculated.	Observed.
LiI	0.528	7.5×10^2	7.2×10^2
NaF	0.856	12.9	12.7
NaBr	0.67	10.1	10.4
KBr	0.726	10.9	10.0
KI	0.626	9.4	9.5
$CaCl_2$	0.673	10.1	10.5
$CaBr_2$	0.600	9.0	9.5
$SrCl_2$	0.724	10.9	11.4
SrI_2	0.511	7.7	7.8

TABLE 7.—*Relation between the heat of formation and melting point as calculated from equation 7.*

		Tm	
	H	Calculated.	Observed.
LiI	65×10^3	7.4×10^2	7.2×10^2
NaF	109	12.3	12.7
NaCl	98	11.1	10.8
KI	80	9.0	9.5
$CaCl_2$	190	10.7	10.5
$SrCl_2$	198	11.1	11.4
$SrBr_2$	171	9.7	9.0
SrI_2	136	7.7	7.8

TABLE 8.—*Relationship between heat of formation and electrolytic decomposition potential P.*

		Heat of formation.	
	P	2.333×10^4 *PZ*	Observed.
LiCl	4.3	1.00×10^5	1.20×10^5
NaF	4.6	1.07	1.09
KF	4.8	1.12	1.18
KCl	4.3	1.00	1.06
KBr	4.0	0.93	0.95
KI	3.5	0.82	0.80
RbF	4.7	1.10	1.08
RbCl	4.3	1.00	1.05
RbBr	4.0	0.93	0.96
$MgCl_2$	2.9	1.35	1.51
$CaCl_2$	3.9	1.82	1.90
$CaBr_2$	3.6	1.67	1.55
CaI_2	3.0	1.40	1.27
BaF_2	4.7	2.19	2.23
$BaCl_2$	4.2	1.96	1.97
$BaBr_2$	3.9	1.82	1.72

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TREMATODE PARASITES OF PHILIPPINE VERTEBRATES, VIII

FLUKES FROM A COBRA AND A CROCODILE

By Marcos A. Tubangui and Victoria A. Masiluñgan

Of the Bureau of Science, Manila

THREE PLATES

Family ACANTHOSTOMIDÆ Poche, 1925

ACANTHOSTOMUM ELONGATUM sp. nov. Plate 1.

This species is represented by a large number of specimens collected from a crocodile. According to Looss (1899), the members of the genus *Acanthostomum* are parasites of fishes and reptiles. The trematode in question is easily distinguished from its relatives reported from fishes (*A. spiniceps, A. absconditus, A. imbutiformis,* and *A. præteritus*) by its very elongated shape and the posterior extent of its vitellaria, which do not reach the level of the ovary. It has, therefore, to be compared only with the remaining member of the genus; namely, *A. coronarium* (Cobbold, 1861), which is also a parasite of crocodiles. According to the brief description of *A. coronarium* given by Cobbold, the Philippine species differs from it in being much larger and in having twenty-one cephalic spines instead of fourteen.[1]

Description.—Body very elongate, with rounded or slightly attenuated extremities, 10.8 to 16.3 millimeters in length by 0.50 to 0.85 millimeter in maximum breadth. Cuticle armed with spines from anterior end to level in front of ovary; the spines are thickly set anteriorly, sparse posteriorly. Oral sucker well-developed, terminal, funnel-shaped, 0.30 to 0.32 by 0.34 to 0.42 millimeter in size, with twenty-one cephalic spines arranged in a single row and measuring 65 to 77 by 19 to 27 microns. Acetabulum very much anterior in position, only a short dis-

[1] Looss (1901) did not find the number of cephalic spines constant in the species of *Acanthostomum* described by him. In *A. elongatum,* however, as well as in another new member of the genus to be described below, the number of these spines has been found to be almost constant.

tance behind oral sucker, 0.30 to 0.36 by 0.31 to 0.36 millimeter in size. Pharynx measures 0.17 to 0.24 by 0.13 to 0.17 millimeter, separated from oral sucker by a prepharynx 0.17 to 0.26 millimeter long; œsophagus practically absent; intestinal cæca long, narrow, reaching to near posterior end of body.

Testes tandem, oval, postovarial, near posterior end of body; anterior testis 0.34 to 0.57 by 0.22 to 0.45, posterior testis 0.30 to 0.47 by 0.22 to 0.32 millimeter in size. Seminal vesicle long, free in parenchyma, in transverse coils between uterine coils and acetabulum. Common genital pore median, immediately preacetabular, leading into a moderately developed sinus.

Ovary oval, immediately pretesticular, to one side of median line, 0.24 to 0.38 by 0.19 to 0.32 millimeter in size. Receptaculum seminis prominent, between ovary and first testis; Laurer's canal present. Shell gland diffuse, to one side of median line opposite ovary. Uterus very long, in transverse coils confined between intestinal cæca and extending from in front of ovary to acetabulum. Vitellaria in small follicles, occupying lateral sides of body from near junction of anterior and middle thirds of body length to a short distance in front of level of ovary. Eggs numerous, thick-shelled, yellowish, operculated, with developed miracidia, 26.8 to 32.6 by 15.3 to 17.2 microns in size.

Excretory bladder roomy, opens exteriorly through a posteroterminal excretory pore.

Specific diagnosis.—Acanthostomum: Body very elongate, 10.8 to 16.3 by 0.50 to 0.85 millimeters in size. Cephalic spines twenty-one, 65 to 77 by 19 to 27 microns in size. Vitellaria from near junction of anterior and middle thirds of body length to a short distance in front of ovary. Eggs with developed miracidia, 26.8 to 32.6 by 15.3 to 17.2 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 474.

ACANTHOSTOMUM ATÆ sp. nov. Plate 2, fig. 1.

Specimens of this fluke were collected from the same host in which *A. elongatum* was found. It was thought in the beginning that it represented a small variety of *A. elongatum,* but a detailed comparison between the two forms showed several specific differences, especially as to size, the number of cephalic spines, and the position of the vitellaria. As a matter of fact the tre-

matode in question bears a closer resemblance to *A. spiniceps* (Looss, 1901) than to *A. elongatum* in the three characters mentioned. It may be distinguished from *A. spiniceps* by its smaller oral sucker, its shorter prepharynx and œsophagus, and its smaller and more anteriorly located acetabulum.

Description.—Body elongate, anterior end truncate, posterior end rounded, 4.1 to 5.5 millimeters in length by 0.3 to 0.5 millimeter in maximum breadth. Cuticle armed with minute spines from anterior end to level of ovary; spines thickly set anteriorly, sparser posteriorly. Oral sucker well-developed, terminal, funnel-shaped, 0.17 to 0.32 by 0.22 to 0.32 millimeter in size, provided with 25 to 26 cephalic spines arranged in a single row and measuring 50 to 58 by 13 to 14 microns. Acetabulum near junction of anterior and second fourths of body length, 0.12 to 0.18 by 0.12 to 0.19 millimeter in size. Prepharynx 0.20 to 0.30 millimeter long; pharynx 0.12 to 0.15 by 0.08 to 0.13 millimeter in size; œsophagus very short, dividing immediately into two intestinal cæca that reach to near posterior end of body.

Testes subglobular, postovarial, near posterior end of body, one immediately behind the other and touching; anterior testis 0.20 to 0.25 by 0.19 to 0.23, posterior testis 0.26 to 0.30 by 0.19 to 0.22 millimeter in size. Seminal vesicle free in parenchyma, coiled, occupying a median position between acetabulum and anterior level of vitelline glands. Common genital pore median, immediately preacetabular, leading to moderately developed genital sinus.

Ovary oval, immediately pretesticular, slightly to one side of median line, 0.24 to 0.28 by 0.17 to 0.21 millimeter in size. Receptaculum seminis large, between ovary and first testis; Laurer's canal present. Shell gland diffuse, small, to one side of median line opposite seminal receptacle. Uterus long, in transverse coils between cæca and extending from in front of ovary to acetabulum. Vitellaria in small follicles occupying lateral sides of body from junction of second and third fourths of body length to level of anterior testis. Eggs numerous, thick-shelled, yellowish, operculated, with developed miracidia, 30.7 to 34.5 by 15.3 to 17.2 microns in size.

Excretory bladder roomy, opens exteriorly through a posteroterminal excretory pore.

Specific diagnosis.—Acanthostomum: Body elongate, 4.1 to 5.5 by 0.3 to 0.5 millimeters in size. Cephalic spines 25 to 26 (in the large majority of cases 26) in number, 50 to 58 by 13 to 14 microns in size. Vitellaria from near junction of second

and third fourth of body length to anterior testis. Eggs with developed miracidia, 30.7 to 34.5 by 15.3 to 17.2 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 500.

Family CLINOSTOMIDÆ Luehe, 1901

HARMOTREMA EUGARI sp. nov. Plate 3, fig. 1.

Specimens of this parasite were presented for determination by Dr. C. M. Africa and Dr. E. Y. Garcia, of the School of Hygiene and Public Health, University of the Philippines.

The genus *Harmotrema* is represented by two species of trematodes parasitic in reptiles; namely, *H. infecundum* Nicoll, 1914, from a West African water snake and *H. laticaudæ* Yamaguti, 1933, from *Laticauda laticaudata* in Japan. The fluke in question is closely related to *H. laticaudæ*, but differs from it in the smaller size of its testes and ovary and in the distribution of its vitellaria, the greater bulk of which occurs in the intercæcal space.

Description.—Body elongate, rounded at both ends, its lateral borders more or less parallel; measures 1.9 to 4.0 millimeters in length by 0.5 to 0.7 millimeter in maximum width. Cuticle unarmed. Oral sucker weak, subterminal, 0.07 to 0.09 by 0.06 to 0.09 millimeter in size; prepharynx absent; pharynx 0.06 to 0.07 millimeter in diameter; œsophagus 0.03 to 0.08 millimeter long; intestinal cæca small in diameter, near median line, reach to near posterior end of body. Acetabulum weak, 0.09 to 0.12 millimeter in diameter, near middle of anterior third of body length or 0.5 to 0.7 millimeter from anterior end of body.

Testes oval, tandem, postequatorial, separated from each other by a space longer than the length of either testis; anterior testis 0.17 to 0.23 by 0.13 to 0.17, posterior testis 0.19 to 0.28 by 0.10 to 0.15 millimeter in size. Cirrus sac large, oval, preëquatorial, lying obliquely between intestinal cæca immediately in front of first testis; measures 0.28 to 0.38 by 0.13 to 0.19 millimeter and incloses a large seminal vesicle, pars prostatica and a protrusible cirrus. The latter is globose to club-shaped, thickly covered with needlelike spines 15 to 23 microns long. Genital pore

ventral to left intestinal cæcum, 0.4 to 0.7 millimeter from acetabulum or 1.0 to 1.5 millimeters from anterior end of body.

Ovary oval, intertesticular, usually nearer to and in contact with second testis; measures 0.12 to 0.17 by 0.10 to 0.15 millimeter. Receptaculum seminis absent, the oviduct being enlarged in diameter and probably serving as seminal receptacle at the same time. Laurer's canal present, opens dorsally opposite anterior level of ovary. Shell gland not prominent, between ovary and vitelline reservoir; latter almost as large as and dorsal to ovary. Vitelline glands in the form of small follicles, mostly confined within intercæcal space and extending from immediately behind acetabulum to blind terminations of intestinal cæca. Uterus very short, leads into a prominent metraterm measuring 0.14 to 0.19 by 0.08 to 0.11 millimeter. Eggs few, yellowish, operculated, 108 to 115 by 69 to 77 microns in size.

Main excretory system similar to that of *H. laticaudæ*, as described by Yamaguti (1933). It consists of four longitudinal excretory vessels, one on each side of an intestinal cæcum. A short distance behind the œsophageal bifurcation the two vessels on each side unite into a single canal that extends anteriorly as far as the base of the oral sucker; posteriorly the same vessels also unite, the common trunk thus formed meeting its fellow at the excretory pore. The latter is posteroterminal in position.

Specific diagnosis.—Harmotrema: Body 1.9 to 4.0 by 0.5 to 0.7 millimeters in size. Cirrus sac preëquatorial, 0.25 to 0.38 by 0.13 to 0.19 millimeter in size. Cirrus globose to club-shaped, thickly covered with needlelike spines 15 to 23 microns long. Common genital opening ventral to left cæcum, 1.0 to 1.5 millimeters from anterior end. Vitellaria in the form of a band, occupying most of intercæcal space not otherwise occupied by other organs from immediately behind acetabulum to termination of intestinal cæca. Eggs few, 105 to 115 by 69 to 77 microns in size.

Host.—Snake (*Naja* sp.).

Location.—Intestine.

Locality.—Biñan, Laguna, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 490.

HARMOTREMA RUDOLPHII sp. nov. Plate 3, fig. 2.

This trematode agrees with the members of the genus *Harmotrema* in the general arrangement of the reproductive organs,

the position of the genital pore, and the structure of the main excretory system. It differs from them in being less elongate; in the more posterior position of the acetabulum, testes, and ovary; and in the more profuse development of the vitellaria.

Description.—Body elongate-oval, 1.9 to 2.2 millimeters in length by 0.6 to 0.7 millimeter in maximum breadth across cirrus pouch or in front of that level. Cuticle unarmed. Oral sucker subterminal, weak, 0.04 to 0.06 by 0.03 to 0.06 millimeter in size; prepharynx absent, pharynx 0.04 to 0.05 millimeter in diameter; œsophagus 0.07 to 0.12 millimeter long; intestinal cæca reach to near posterior end of body. Acetabulum weak, 0.13 to 0.15 millimeter in diameter, near middle of second fourth of body length.

Testes globular to oval, tandem, near posterior end of body; first testis 0.28 to 0.29 by 0.23 to 0.29, second testis 0.20 to 0.30 by 0.20 to 0.26 millimeter in size. Cirrus sac large, immediately postequatorial, 0.34 to 0.56 by 0.20 to 0.25 millimeter in size; incloses large seminal vesicle, pars prostatica, and protrusible cirrus. The latter is moderately long and provided with numerous small spines. Common genital pore ventral to left intestinal cæcum, near middle of third fourth of body length or 0.8 to 1.0 millimeter from posterior end of body.

Ovary oval, sometimes triangular in outline, to right side of median line in intertesticular zone, forming with testes a sort of triangle; measures 0.14 to 0.17 by 0.12 to 0.17 millimeter. Receptaculum seminis absent, Laurer's canal present. Shell gland submedian, between ovary and second testis. Vitellaria profuse, occupying most of space not otherwise occupied by other organs from slightly in front of acetabular level to posterior end of body; the anterior portion of the body in which the vitelline glands do not occur is distinguished by its lighter color. Uterus short, leads into prominent metraterm; latter immediately behind cirrus sac and measures 0.30 to 0.38 by 0.08 to 0.13 millimeter. Eggs few, yellowish, operculated, 109 to 133 by 69 to 77 microns in size.

Main excretory system very similar to that of *H. eugari.* Excretory pore posteroterminal.

Specific diagnosis.—Harmotrema: Body elongate-oval, 1.9 to 2.2 by 0.6 to 0.7 millimeters in size. Cirrus sac postequatorial, 0.34 to 0.56 by 0.20 to 0.25 millimeter in size. Common genital opening in third fourth of body length, 0.6 to 1.0 millimeter from posterior end of body. Vitellaria profuse, occupying most of

space not otherwise occupied by other organs from immediately in front of acetabular level to posterior end of body. Eggs few, 109 to 133 by 69 to 77 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 491.

Family ALARIIDÆ Tubangui, 1922

NEODIPLOSTOMUM CROCODILARUM sp. nov. Plate 2, fig. 2.

This is the second member of the genus *Neodiplostomum* Railliet, 1919, to be reported from the Philippines, the first one being *N. aluconis* Tubangui, 1933, from an owl. The genus, as defined by Dubois (1935), includes the following other strigeid trematodes: *N. spathula* (Creplin, 1829); *N. spathulaforme* (Brandes, 1891); *N. siamense* (Poirier, 1886); *N. poirieri* Dubois, 1932; *N. gavialis* Narain, 1930; *N. longum* (Brandes, 1891); *N. ellipticum* (Brandes, 1891); *N. bifurcatum* (Wedl, 1861); *N. pseudospathula* (Brandes, 1891); *N. cochleare* (Krause, 1914); *N. grande* (Diesing, 1850); *N. attenuatum* von Linstow, 1906; *N. kashmirianum* Faust, 1927; *N. pseudattenuatum* (Dubois, 1927); *N. morchelloides* Semenow, 1927; *N. fungiloides* Semenow, 1927; and *N. impræputiatum* Dubois, 1934. The trematode in question most closely resembles the first five of the parasites enumerated above in the relative lengths of the anterior and posterior body regions and in the presence of papillalike structures in the holdfast organ. In *N. crocodilarum,* however, the number of papillæ in the holdfast organ is from 25 to 35, in *N. siamense* 40, and in *N. gavialis* 70; in *N. spathula* and *N. spathulaforme* the number of the papillæ is not given in the available literature. The Philippine species may further be differentiated from its near relatives by the distribution of its vitelline glands.

Description.—Body with a total length of 4.2 to 5.2 millimeters, divided distinctly into two regions. Forebody more or less conical, flattened dorsoventrally, 2.3 to 2.7 millimeters in length by 0.80 to 0.95 millimeter in maximum diameter; hindbody more or less cylindrical, 1.8 to 2.6 millimeters in length by 0.60 to 0.85 millimeter in maximum diameter. Oral sucker terminal, 0.04 to 0.06 by 0.05 to 0.06 millimeter in size; prepharynx absent; pharynx 0.04 to 0.05 by 0.03 to 0.04 millimeter in size; œsophagus

0.06 to 0.11 millimeter long; intestinal cæca narrow in diameter, reach to near posterior end of body. Acetabulum weak, 0.09 to 0.11 by 0.10 to 0.13 millimeter in size, immediately behind junction of first and second thirds of length of forebody. Holdfast organ more or less elliptical, 0.85 to 1.15 by 0.30 to 0.50 millimeters in size, in posterior half of forebody, possesses an elliptical opening and its inner border shows the presence of 25 to 35 prominent papillalike structures. A definite adhesive gland, as seen in other strigeid trematodes, is lacking; in its place are a few intensely staining cells dorsal to the holdfast organ.

Testes large, tandem, postovarial, in middle third of hindbody length; anterior testis measures 0.48 to 0.58 by 0.55 to 0.78, posterior testis 0.50 to 0.70 by 0.57 to 0.80 millimeter. Vesicula seminalis much coiled, immediately behind second testis. A well-developed bursa not apparent. Genital pore dorsoterminal at posterior end of hindbody, opening into a roomy genital atrium. Latter is guarded dorsally by a muscular, conical prolongation of the hindbody.

Ovary roundish to oval, at middle of anterior third of hindbody length, 0.19 to 0.24 by 0.19 to 0.30 millimeter in size. Uterus short, reaches anteriorly to near junction between cephalic and caudal body regions and then bends posteriorly as a more or less straight tube leading to common genital pore. Shell gland and vitelline reservoir between testes, the former on the left and the latter on the right of median line. Laurer's canal narrow in diameter, wavy in outline, opens on the dorsal surface opposite anterior border of first testis. Vitellaria moderately developed, extending from immediately or a short distance behind acetabulum to anterior or middle level of first testis; the greater bulk of the glands is found in the forebody, in and around the holdfast organ. Eggs few, yellowish, operculated, thin-shelled, 104 to 120 by 54 to 65 microns in size.

Excretory system of the typical holostome type, the median and the two lateral excretory vessels being very conspicuous in the forebody. Excretory pore ventro-subterminal at posterior end.

Specific diagnosis.—Neodiplostomum: Body 4.2 to 5.2 millimeters in total length, distinctly divided into two regions; forebody 2.3 to 2.7 by 0.80 to 0.95, hindbody 1.8 to 2.6 by 0.60 to 0.85 millimeters in size. Holdfast organ with 25 to 35 papillalike structures. Vitellaria from immediately or a short distance

behind acetabulum to anterior or middle level of first testis. Eggs few, 104 to 120 by 54 to 65 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 475.

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ILLUSTRATIONS

PLATE 1

Acanthostomum elongatum sp. nov., entire worm, ventral view.

PLATE 2

FIG. 1. *Acanthostomum atæ* sp. nov., entire worm, ventral view.
2. *Neodiplostomum crocodilarum* sp. nov., entire worm, ventral view.

PLATE 3

FIG. 1. *Harmotrema eugari* sp. nov., entire worm, ventral view.
2. *Harmotrema rudolphii* sp. nov., entire worm, ventral view.

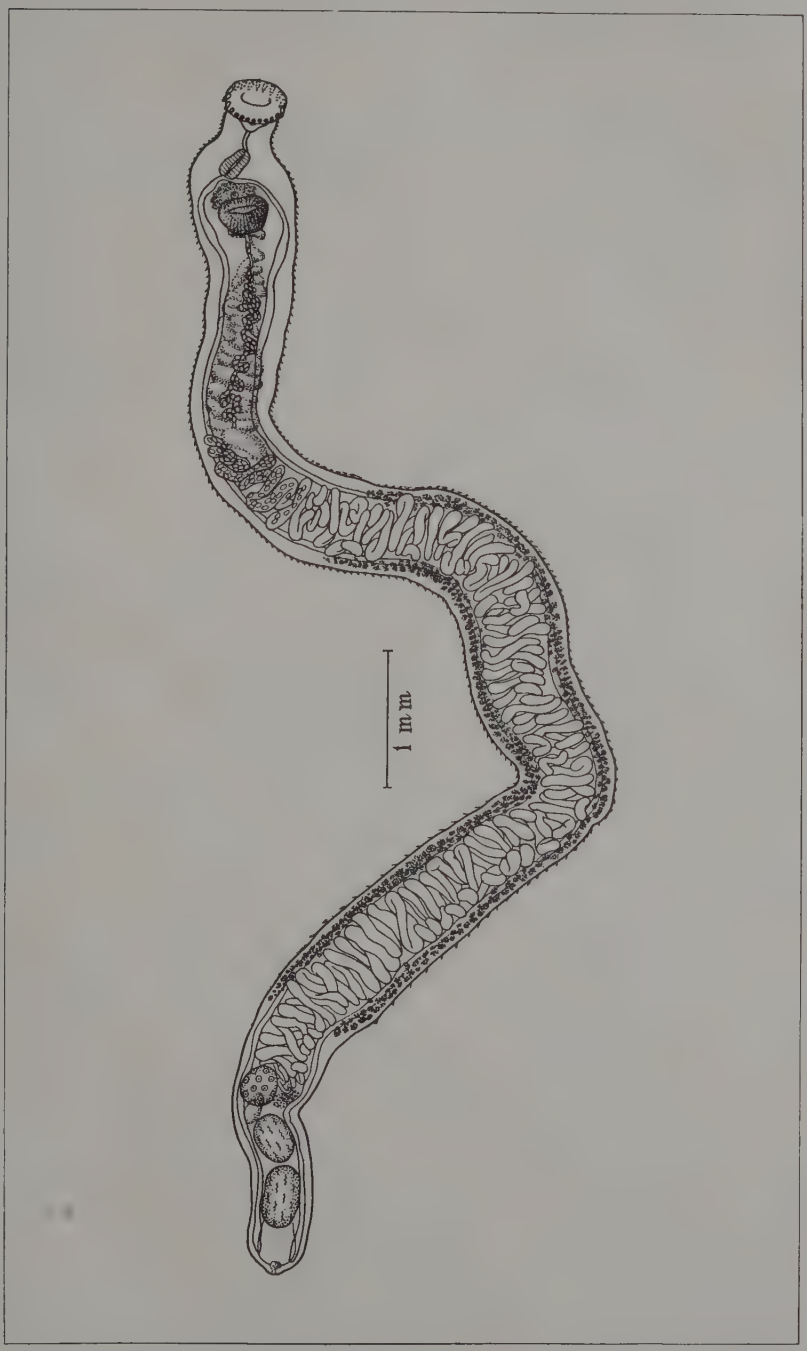

PLATE 1.

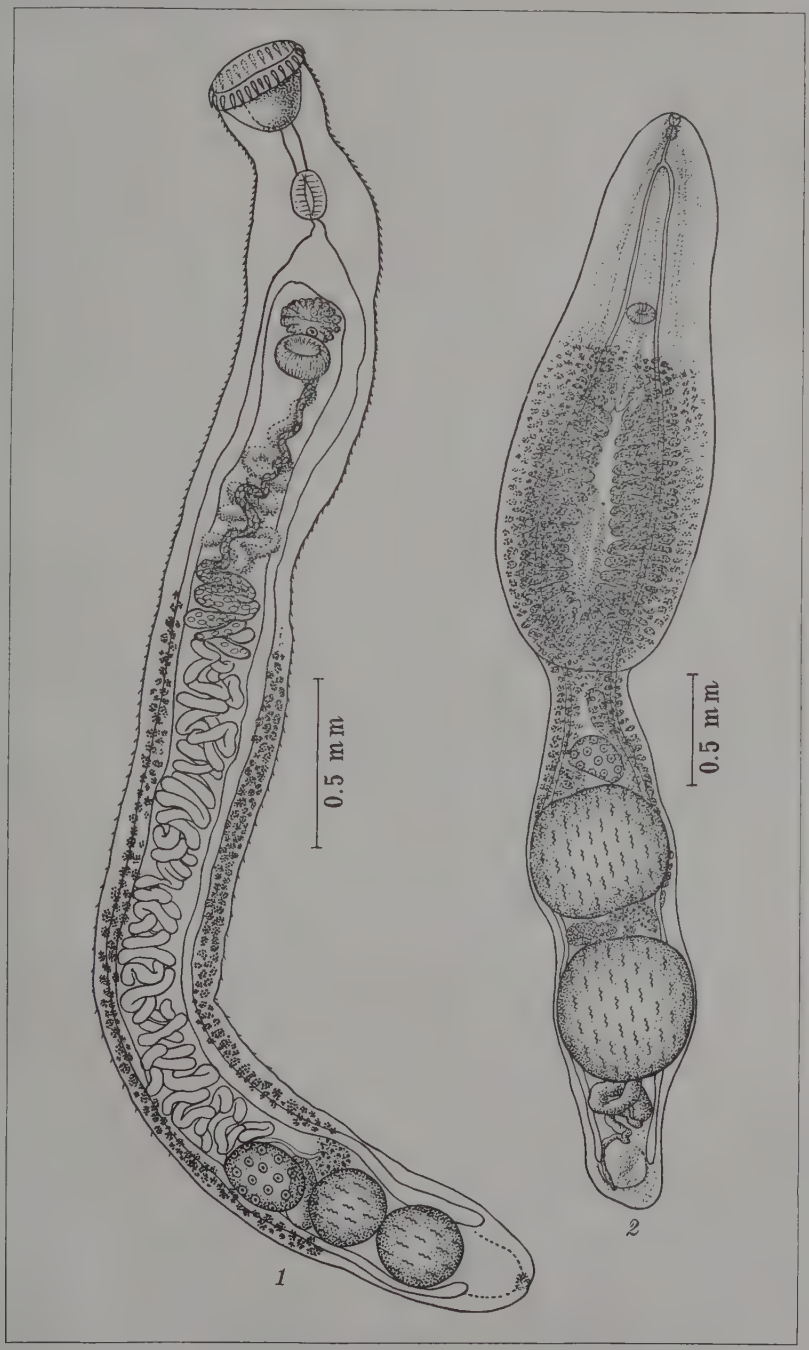

PLATE 2.

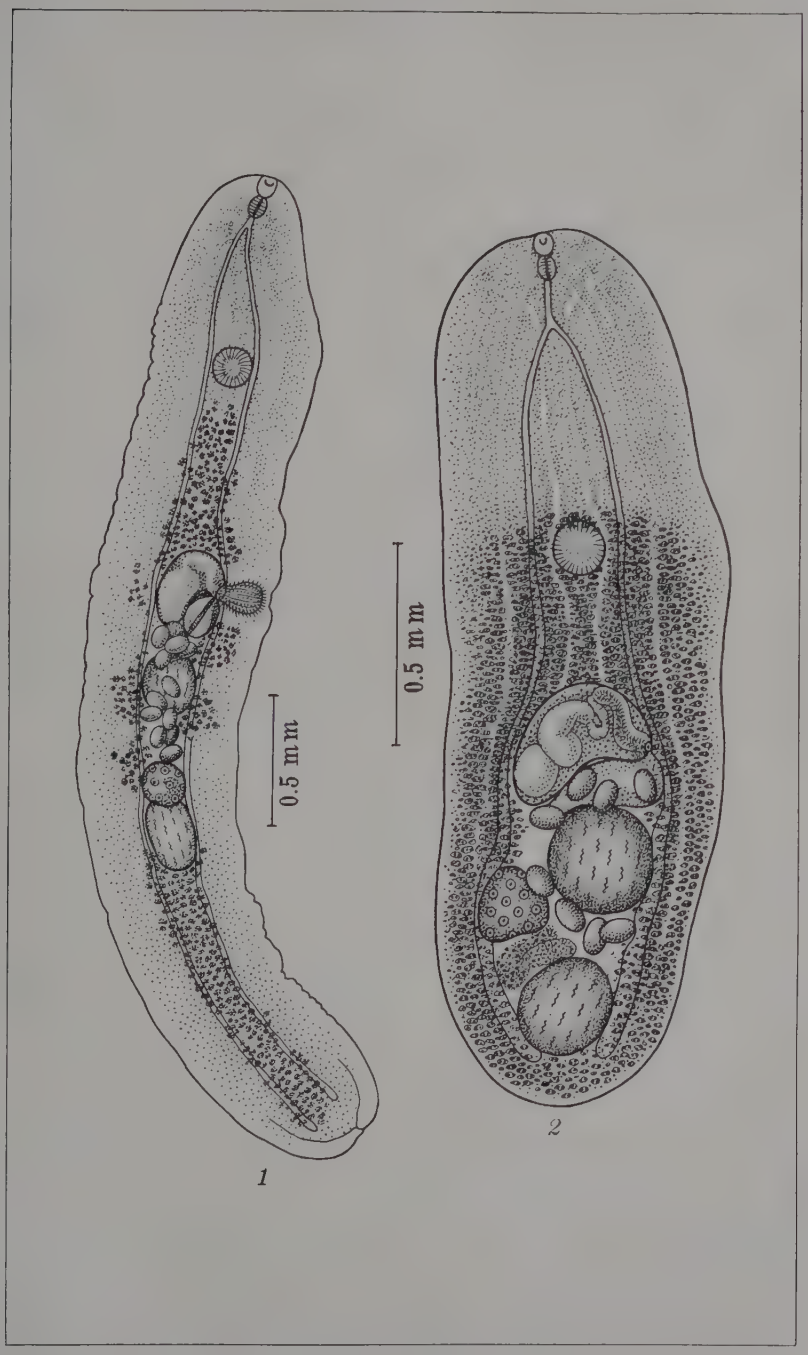

PLATE 3.

THE PLEURAL HAIRS OF CULICINE MOSQUITO LARVÆ

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FOUR PLATES

INTRODUCTION

The pleural hairs of mosquito larvæ consist of three paired groups of four hairs each, lying ventrolaterally on the thorax. The four hairs of each group all arise from a single chitinized tubercle, which facilitates their recognition. In an entire mounted larva it can be seen that each pair of groups arises in proximity to the imaginal discs of the legs of the corresponding segment of the thorax, and it is believed that these groups of hairs, in fact, represent the last remnant of the legs of the larva.

Although incidental descriptions of the pleural hairs of certain *Anopheles* larvæ were given by Martini (1923) and Root (1924), Puri (1928) first pointed out the great value of the pleural hairs in classifying the larvæ of the Indian species of *Anopheles* into natural groups. This is particularly true as regards the larvæ of the subgenus *Myzomyia,* which includes the dominant anophelines of the tropical part of the Old World. Root (1931) recently examined the pleural hairs of the anopheline larvæ of the New World and found that the group distinctions based on the pleural hairs are much less clearly marked in the larvæ of the subgenera *Anopheles* and *Nyssorhynchus.*

Practically nothing has been published on the pleural hairs of the larvæ of culicine mosquitoes. It seemed worth while, therefore, to undertake a systematic examination and description of the pleural hairs of all the culicine larvæ represented in the collection of Dr. F. M. Root, professor of medical entomology of Johns Hopkins University, in order to see what light these structures would throw on the relationships of the genera and subgenera, and if characters of use for classification and identification could be discovered. This investigation was suggested to me by Doctor Root and carried on under his direction and super-

vision. I acknowledge my indebtedness to him for many helpful suggestions and criticisms during the progress of the work, as well as for considerable assistance in the interpretation of my results and in the writing of this paper.

TERMINOLOGY

The groups of pleural hairs are segmentally arranged on the thorax, so that they may be naturally termed the prothoracic, mesothoracic, and metathoracic groups. In order to abbreviate these terms, the prothoracic group may be called "group I;" the mesothoracic group, "group II;" and the metathoracic group, "group III."

Careful examination of the origin of the four hairs of a single group or the sockets left when they are removed shows that the four hairs may be divided into two pairs, an anterior and a posterior, each containing two hairs, one dorsal and the other ventral. The four hairs, then, may be conveniently spoken of as "the anterior ventral" (or briefly av), "the anterior dorsal" (ad), "the posterior ventral" (pv), and "the posterior dorsal" (pd). If it is desired to refer to one particular hair, the group number is prefixed to one of these abbreviations, to indicate the group to which the hair belongs; thus, "I–ad" refers to the anterior dorsal hair of the prothoracic group.

In describing the hairs briefly, it is desirable to indicate both their comparative length and their mode of branching. Since in many genera the entire prothoracic group is very small in comparison with the other two, it seems best to describe the length of each hair by a rough comparison with the longest hair of the particular group to which it belongs. Hairs that are equal to or not much shorter than the longest hair of the group are termed simply "long." Hairs that are from one-half to three-quarters as long as the longest hair are called "fairly long." Hairs about one-fourth or one-third as long as the longest hair are called "short," while those that are much less than one-fourth as long as the longest hair are referred to as "very short." If such a very short hair is stout and spinelike, instead of slender and flexible, it is called a "spine."

Puri (1928), in a study of the mode of branching of the pleural hairs, has shown that in the Indian *Anopheles* larvæ the long pleural hairs may be either "single;" that is, entirely without branches; "split" about the middle of their length into a small number of branches; or "feathered," having a series of short

lateral branches on each side of the hair. In culicine larvæ all the hairs, including the pleural hairs, are apt to bear a large number of delicate lateral branches, which might lead one to refer to them as feathered. It seems best, however, to ignore these delicate lateral branches, and in this paper hairs that possess only such branches will be referred to as "single."

Hairs that are "split," much as in the anopheline larvæ, are sometimes found in culicines, also, but the mode of branching of the pleural hairs that is most characteristic of the culicines is a splitting of the hair at its extreme base into a variable number of branches, which all lie in the same plane, like the sticks of a fan, producing a flat, fan-shaped tuft. Where the number of branches is small, such hairs are called "double, triple, 4-branched," or "5-branched," but when there are six or more branches the tuft is simply referred to as a "fan." In a few larvæ, belonging to subgenera addicted to tree holes and similar breeding places, one of the prothoracic pleural hairs is divided at its base into a number of (usually) short branches, arising in a clump and projecting in different directions, thus forming a "stellate tuft," much like many others in different locations on the thorax and the abdomen of such larvæ. In *Megarhinus* one pleural hair in each group is much thicker than the others and covered with spinelike projections. This type of hair is called "stout spinose."

In the names of species and their allocation to genera and subgenera, Dyar's Mosquitoes of the Americas (1928) has been followed, except in a few instances where changes were obviously necessary.

To facilitate rapid reference to the number of long hairs in the different groups of pleural hairs, the number of long or fairly long hairs in each group is written, beginning with the prothoracic group, with the numbers representing the long hairs in the different groups separated by dashes. This is called the "formula" for that species or genus. Thus, the formula for *Anopheles* is 3–2–2, indicating that there are three long hairs in the prothoracic group, two in the mesothoracic group, and two in the metathoracic group.

GENERAL SURVEY OF THE PLEURAL HAIRS OF CULICINE LARVÆ

The detailed descriptions of the pleural hairs of the larvæ examined in the course of this study will be found in a table at the end of this paper. In the body of the paper will be taken

up only a general survey of the variations undergone by the various groups and hairs and then as applied to the recognized classificatory divisions of tribes, groups, genera, and, in some cases, subgenera.

REDUCTION IN SIZE OF THE ENTIRE PROTHORACIC GROUP OF PLEURAL HAIRS

In some of the mosquito larvæ, particularly those of the Anophelini, *Megarhinus, Theobaldia, Wyeomyia,* and *Limatus,* the pleural hairs of the prothoracic group are of practically the same size as those of the other groups. In most of the culicines, however, the prothoracic group is definitely smaller than the others; and in some—such as, *Aëdeomyia, Orthopodomyia,* most species of *Culex* and *Aëdes,* and the subgenus *Psorophora*—the prothoracic pleural hairs are less than half as large as those of the other groups.

THE NUMBER OF LONG OR FAIRLY LONG HAIRS IN EACH GROUP

In *Anopheles,* as Puri (1928) and Root (1931) have pointed out, there are three long hairs in the prothoracic group and two each in the mesothoracic and metathoracic groups, giving the formula 3–2–2. Root (1931) has shown that in *Chagasia* the formula is 3–2–3, which may perhaps be looked upon as more primitive than that of *Anopheles,* since one may presume that originally all four hairs were of equal length, as is the case in the prothoracic and mesothoracic groups of *Dixa.* In the majority of culicine larvæ the formula is 3–3–2, although there are many exceptions, as will be noted later.

VARIATIONS OF THE PLEURAL HAIRS

In general, the prothoracic group is much the most variable one, while the mesothoracic group shows very little variation and the metathoracic group only slightly more.

Of the individual hairs the anterior dorsal hair usually shows the greatest variation and is the most highly specialized. This hair is particularly likely to assume the shape of a fan, especially in the mesothoracic and metathoracic groups.

The anterior ventral hair, also, shows a certain amount of variation and specialization in the prothoracic group, although it is usually long and single in the mesothoracic and metathoracic groups.

The two hairs of the posterior pair exhibit comparatively little variation. The posterior ventral is almost always single, and

is usually long in the prothoracic and mesothoracic groups, short in the metathoracic group.

The posterior dorsal is always short, often very short, and relatively inconspicuous except in certain sabethine larvæ, where it assumes the form of a spine. It is not improbable that this hair is absent altogether at times, but its small size makes it very difficult to be sure of this, without access to more plentiful and better-preserved material than that examined by me.

THE PROTHORACIC GROUP OF PLEURAL HAIRS

In the culicine larvæ, the prothoracic group of pleural hairs is the most significant and valuable for classificatory purposes. Several different groups can be distinguished on this basis.

In *Megarhinus* the three long hairs of the group are all single, but I–ad is stout and spinose. In *Aëdeomyia* the size of the whole prothoracic group is greatly reduced, but the three long hairs are all single and of about the same length.

In the great majority of the American sabethine genera both I–av and I–ad are more or less branched. The amount of this branching ranges from a double hair to a fan with a considerable number of branches. In some groups the two hairs are branched alike, in others the anterior dorsal has a greater number of branches than the anterior ventral. In the subgenera *Melanolepis* and *Decamyia* (both placed in *Dendromyia* by Dyar) hair I–pv is also slightly branched, but in the majority of sabethines it is a long single hair. In *Wyeomyia,* subgenera *Nunezia* and *Dodecamyia,* none of the long prothoracic hairs is branched, in decided contrast to the other forms examined. The hair I–pd is always small, but is spinelike in *Goeldia* and *Isostomyia magna,* also in the subgenera *Dinomyia* and *Melanolepis.* In *Joblotia* I–av is single, though I–ad is branched.

Among the true culicine genera there are a few that have the anterior dorsal prothoracic pleural hair branched. In *Uranotænia* (American species) it is usually double, and in *Orthopodomyia* it forms a fan. In the subgenus *Psorophora* all three of the long prothoracic hairs are split into a number of branches at about the middle of their length.

In the remaining culicine mosquitoes hair I–pv is invariably long and single; hairs I–av and I–ad are usually single, but vary considerably in length in different genera. Three groups may be distinguished on this basis. In *Aëdes* (subgenera *Ochlerotatus, Aëdimorphus,* and *Stegomyia*), *Psorophora* (subgenus

Grabhamia), and in *Theobaldia inornata* both I–av and I–ad are fairly long. This is also the case in *Aëdes* (*Finlaya*) *atropalpus* and *fluviatilis*. In most species of the subgenera *Finlaya* and *Howardina* of *Aëdes*, however, hair I–av is fairly long and single while hair I–ad is branched, varying from a short double or triple hair in *Finlaya* to a short stellate tuft or a fairly long 4-branched hair in species of *Howardina* and in *Hæmagogus*. In *Aëdes* (*Aëdes*) *cinereus*, also, hair I–ad is double or triple and fairly long.

In certain species of *Culex* (mainly species breeding in water held by plants and belonging to the subgenera *Carrollella*, *Melanoconion*, and *Microculex*, but also including *Culex corniger*) hair I–ad is fairly long, while hair I–av is short. This condition is also found in *Deinocerites cancer*, in *Theobaldia dyari* and *melanura*, and in *Psorophora*, subgenus *Janthinosoma*.

In most species of *Culex*, in *Mansonia*, and in *Psorophora* (*Grabhamia*) *discolor* both hairs I–ad and I–av are short, leaving I–pv as the only really long hair in the prothoracic group.

THE MESOTHORACIC GROUP OF PLEURAL HAIRS

The characteristic arrangement of the hairs of this group, throughout the whole culicine series, is for hairs II–av and II–pv to be long and single while hair II–ad is branched (usually forming a fan) and II–pd is very short, as usual.

Variations from this type are not very numerous. In *Megarhinus* the hairs of the mesothoracic group agree precisely with those of the prothoracic group; that is, the three long hairs are single and II–ad is stout and spinose. In *Aëdeomyia* the description of the mesothoracic group reads much like that of the prothoracic group, hairs II–av and II–ad being long and single and II–pv fairly long and single, but in actual length these long hairs vastly exceed those of the prothoracic group and they show short spiny side branches very different from the usual delicate ones.

While hair II–ad is usually developed into a definite fan, there are many species, especially among the sabethines, where this fan has only two, three, or four branches. This is the case in all species of *Joblotia*, *Wyeomyia*, *Dendromyia*, and *Limatus* examined, except in the subgenera *Wyeomyia* and *Dodecamyia*, where this hair is single. In *Goeldia*, *Isostomyia*, and *Sabethoides* it is definitely fanlike.

In *Mansonia,* also, II–ad is rather few-branched, often triple, and in *Aëdes* (*Stegomyia*) *ægypti* it is double in all the larvæ I have examined.

Peculiarly enough, while the mesothoracic group is absolutely normal and usual in the subgenera *Grabhamia* and *Janthinosoma* of *Psorophora,* in the subgenus *Psorophora* it varies decidedly from the usual type. Here II–ad is long and single, II–av varies from short and split into a number of branches to fairly long and split into two branches, while II–pv is fairly long and single in some species and short and split in others.

Throughout the whole series of larvæ examined, hair II–pd is uniformly very short and is developed into a spine only in *Goeldia, Isostomyia,* and the subgenera *Dinomyia* and *Melanolepis.*

THE METATHORACIC GROUP OF PLEURAL HAIRS

Here again the majority of the culicines conform to a general type, in which III–av is long and single, III–ad is branched (usually a fan), III–pv is short and usually single, and III–pd is very short.

Megarhinus and *Aëdeomyia* are exceptions, as usual. In *Megarhinus* the metathoracic group is essentially like the other two groups, III–ad being stout and spinose, although in this group III–pv is shorter than in the others and can only be called fairly long. In *Aëdeomyia* III–ad is long and single, but III–pv is short and single, as in the usual type.

As was the case in the mesothoracic group, a number of species, mainly sabethines, have hair III–ad few-branched, although the branching is of the fanlike type. This is true of *Joblotia, Limatus,* and *Wyeomyia* (subgenera *Wyeomyia, Phyllozomyia,* and *Pentemyia*); of *Dendromyia* (*Dinomyia*) *mystes,* among the sabethines; and of *Mansonia, Aëdes* (*Stegomyia*) *ægypti,* and *Aëdes* (*Ochlerotatus*) *hastatus* among the true culicines.

In a few groups, among both sabethines and culicines, hair III–pv is long or fairly long instead of short, although it remains single. This variation occurs in *Culex* (subgenus *Mochlostyrax*), in *Psorophora* (subgenera *Grabhamia* and *Janthinosoma*) among the culicines, and in *Joblotia* and *Wyeomyia* (*Pentemyia*) *bromeliarum* among the sabethines.

Hair III–pd is always very short, and is developed into a spine in *Joblotia digitata, Goeldia,* and *Isostomyia,* and in all species of *Dendromyia* examined with the possible exception of *Den-*

dromyia (*Dinomyia*) *mystes*. In *Dendromyia* (*Calladimyia*) *melanoides* this spine is three-pointed, and in the species of *Dendromyia* (*Decamyia*) it is unusually large.

As is true in the mesothoracic group, the pleural hairs of the metathoracic group in *Psorophora* (*Psorophora*) do not conform to the usual type. Again hair III–pd is long and single, while III–av is about half the length of III–ad and is sometimes single, sometimes split into two or three branches. Hair III–pv is short and split into a small number of branches.

VARIATIONS IN THE PLEURAL HAIRS AS RELATED TO CLASSIFICATORY GROUPS

The tribes and groups used in the classification of mosquito genera are still in a somewhat unsatisfactory state, two systems being employed; one, by Dyar, considers only the American mosquitoes, the other, by Edwards, deals with the mosquitoes of the whole world. Both of these authorities, however, are agreed upon the same general grouping of the genera, and differ mainly as to whether certain sets of genera should be called groups or tribes. These two arrangements, together with a list of the American genera considered in this paper which are placed in the various groups, are given in Table 1.

TABLE 1.—*Tribes and groups of mosquitoes and the American genera considered in this paper.*

Classification of—		Genera.
Edwards.	Dyar.	
Tribe Anophelini	Tribe Anophelini	*Anopheles, Chagasia.*
Tribe Megarhinini	Tribe Megarhinini	*Megarhinus.*
Tribe Culicini:		
Uranotænia group	Tribe Uranotænini	*Uranotænia.*
Sabethes group	Tribe Sabethini	*Sabethoides, Wyeomyia.*
	Tribe Culicini	*Dendromyia, Limatus, Goeldia, Isostomyia, Joblotia.*
Theobaldia-Mansonia group	Aëdeomyia group	*Aëdeomyia.*
	Orthopodomyia group	*Orthopodomyia.*
	Theobaldia-Mansonia group	*Theobaldia, Mansonia.*
Aëdes group	Aëdes group	*Aëdes, Psorophora, Hæmagogus.*
Culex group	Culex group	*Culex, Lutzia, Deinocorites.*

Naturally enough, since this study deals almost exclusively with American mosquito larvæ, the classification of Dyar is found to correspond best with my results and will be followed

in the tabulation of tribal and group characters based on the pleural hairs which follows.

It is to be remembered, of course, that the following statements of characters are based entirely on the examination of a rather limited series of species of purely New World origin, so that they will undoubtedly require modification after other workers have studied more material, especially from the Old World.

1. Tribe Anophelini. With two long hairs in the mesothoracic group (hair II–pv short).
   - Genus *Anopheles*. Two long hairs in the metathoracic group (hair III–pv short).
   - Genus *Chagasia*. Three long hairs in the metathoracic group (hair III–pv long).
2. Tribe Megarhinini (only a single genus, *Megarhinus*). Three long hairs in each group, hair ad of each group stout and spinose.
3. Tribe Uranotænini (only a single American genus, *Uranotænia*). Prothoracic group with only two long hairs, of which one (hair I–ad) is few-branched.
4. Tribe Sabethini. The majority of the species examined can be distinguished from all other American mosquito larvæ by the presence of two long branched hairs (I–av and I–ad) in the prothoracic group. Exceptions to this rule are *Joblotia*, with only one long branched hair, and *Wyeomyia* (subgenera *Nunezia* and *Dodecamyia*) with none.
   - Genus *Joblotia*. Three long hairs in the metathoracic group; only one long branched hair in the prothoracic group.
   - Genera *Goeldia* and *Isostomyia*. Two long hairs in the metathoracic group; two long branched hairs in the prothoracic group; hair pd of all groups a spine.
   - Genus *Dendromyia* (subgenus *Dinomyia*). Same as *Goeldia* and *Isostomyia*.
   - Genus *Dendromyia* (subgenus *Melanolepis*). Same as *Goeldia* and *Isostomyia*, except that there are three long branched hairs in the prothoracic group.
   - Genus *Dendromyia* (subgenera *Calladimyia* and *Heliconiamyia*). Same as *Goeldia* and *Isostomyia* except that hair pd is converted into a spine only in the metathoracic group.
   - Genus *Dendromyia* (subgenus *Decamyia*). Same as *Calladimyia* and *Heliconiamyia*, except that there are three long branched hairs in the prothoracic group.
   - Genus *Wyeomyia* (subgenus *Phyllozomyia*, plus *W. longirostris*). Formula 3–3–2; two long branched hairs in the prothoracic group, one in each of the other groups.
   - Genus *Wyeomyia* (subgenus *Wyeomyia*, excluding *W. longirostris*). Same as *Phyllozomyia*, except that there is no long branched hair in the mesothoracic group.
   - Genus *Wyeomyia* (subgenus *Pentemyia*). Same as *Phyllozomyia*, except that there are three long hairs in the metathoracic group (formula 3–3–3).

Genus *Wyeomyia* (subgenus *Dodecamyia*). Same as *Phyllozomyia*, except that there is no long branched hair in either prothoracic or mesothoracic group.

Genus *Wyeomyia* (subgenus *Nunezia*). Same as *Phyllozomyia*, except that the prothoracic group has only two long hairs (formula 2–3–2), neither of which is branched.

Genus *Limatus*. Same as *Phyllozomyia*.

Genus *Sabethoides*. Same as *Phyllozomyia*, except that both of the long branched hairs of the prothoracic group are definite fans.

NOTE.—Although the American sabethine genera show many variations, as can be seen from the tabulation just given, the basic formula is evidently 3–3–2 and the most common condition as to long branched hairs shows two in the prothoracic group and one in each of the other groups.

5. Tribe Culicini. With three long hairs in the mesothoracic group (only one in subgenus *Psorophora*) and with one, two, or three long hairs in the prothoracic group, all usually single. The typical formulæ, then, are 1, 2, or 3–3–2, with one fan in each of the mesothoracic and metathoracic groups.

Aëdeomyia group (genus *Aëdeomyia*). Formula 3–3–2; none of the long hairs branched.

Orthopodomyia group (genus *Orthopodomyia*). Formula 3–3–2; one long branched hair ("fan") in each group.

Theobaldia-Mansonia group.

Theobaldia inornata. Same as *Aëdes* (*Ochlerotatus*), below (formula 3–3–2).

Theobaldia dyari and *melanura*. Same as *T. inornata* except that hair I–av is short (formula 2–3–2).

Mansonia. Same as typical *Culex*, below (formula 1–3–2).

Aëdes group.

Aëdes (subgenera *Ochlerotatus*, *Aëdimorphus*, and *Stegomyia*). Formula 3–3–2; one branched hair in the mesothoracic and one in the metathoracic group.

Aëdes (subgenera *Finlaya* and *Howardina* and *Aëdes cinereus*). Same as above except that hair I–ad is usually branched and is often short.

Hæmagogus. Same as *Aëdes* (*Finlaya* and *Howardina*).

Psorophora (subgenus *Grabhamia*). Hair III–pv fairly long, making the formula 3–3–3.

Psorophora (*Grabhamia*) *discolor*. I–av and I–ad short, formula 1–3–3.

Psorophora (subgenus *Janthinosoma*). I–av short, III–pv long, formula 2–3–3.

Psorophora (*Janthinosoma*) *cyanescens*. I–av fairly long and double, formula 3–3–3.

Psorophora (subgenus *Psorophora*). Formula usually 3–3–2. One long single hair in the mesothoracic, and one in the metathoracic, group. All the other fairly long hairs split into several branches beyond base.

Culex group.

Culex (subgenera *Culex*, *Choeroporpa*, and pool-dwelling *Melanoconion*). In the normal series of *Culex* species which inhabit permanent ground pools, only one hair of the prothoracic group is long (hair I–pv), giving the formula 1–3–2.

Culex [subgenera *Carrollella*, and *Microculex*, species of *Melanoconion* living in water held by plants, and *C.* (*Culex*) *corniger*]. Hair I–av is fairly long, giving the formula 2–3–2.

Culex (subgenus *Mochlostyrax*). Hair III–pv is fairly long, giving the formula 1–3–3.

Deinocerites. Hair I–ad long; formula 2–3–2.

THE PLEURAL HAIRS OF THE OLD WORLD CULICINE LARVÆ

Since pleural hairs of the larvæ, either New or Old World species, play such an important rôle in entomological studies, an examination of the Old World species at this point is not out of place and a few of the possibilities may be discussed. It is obvious that the number of Old World species examined is small and requires further study, but for the moment, and until further work definitely establishes a fact to the contrary one may compare them with the results obtained with the related American species as follows:

Genus *Culex*. Species examined, *Culex* (*Culex*) *sitiens*, *Culex* (*Culex*) *pacificus*, and an unidentified larva evidently belonging to *Culex* (*Lophoceratomyia* or *Culiciomyia*). These all had the formula 1–3–2, agreeing with the normal series of American *Culex* larvæ.

Genus *Lutzia*. *Lutzia tigripes*. Although *Lutzia* is sometimes considered only a subgenus of *Culex*, this species had the aëdine formula 3–3–2, both I–av and I–ad being fairly long and single. A skin of the American *Lutzia brasiliæ* was also examined. All the prothoracic pleural hairs had been broken off, but from the appearance of their sockets it seemed probable that its formula would be the same as that of the Old World species.

Genus *Aëdes*. Three species were examined.

Aëdes (*Stegomyia*) *variegatus* had the typical aëdine formula, 3–3–2, and hair I–ad was fairly long and single, as in *Aëdes ægypti*. The "fans" of the mesothoracic and metathoracic groups were much better developed than in the latter species, where they are only double.

Aëdes (*Finlaya*) *albilabris* agreed with most of the American species of *Finlaya* in having hair I–ad short and branched (double in this case). Otherwise it was typically aëdine.

Aëdes (?) *albolineatus* is of especial interest because it does not fit well into the subgeneric classification of *Aëdes*. It is usually placed in *Stegomyia* with a question mark. The coloration of the adult

agrees with *Stegomyia*, the male hypopygium is partly like *Stegomyia*, partly like *Aëdimorphus*, and the male palpi are unusually short for either of these subgenera, yet not short enough to throw it into *Aëdes* or *Skusea*. To add to the confusion, the pleural hairs of the larva prove to be most like those of *Finlaya* or *Howardina*, I–ad being fairly long, but branched into a stellate tuft, like others on the thorax and abdomen of this larva.

Genus *Rachionotomyia*. This is a genus of Old World sabethines, believed by Edwards to be nearest to *Goeldia* of the American forms. Two species were examined, *R. caledonica* and an unidentified species closely related to it, both from the New Hebrides. In both, the pleural hairs were exactly like those of *Orthopodomyia*, the formula being 3–3–2, with one long fan in each of the groups. This does not agree exactly with the pleural hairs of any of the numerous types found among the American sabethines.

Genus *Uranotænia*. Only one species, *U. quadrimaculata*, was examined. The pleural hairs of this species differ very decidedly from the uniform type presented by the five species of American *Uranotænia* examined. This can be seen best by direct comparison, as given below.

American *Uranotænia*. Formula 2–3–2. I–ad double; II–ad and III–ad fans.

Uranotænia quadrimaculata. Formula 1–2–2. None of the long hairs branched.

Unless the specimens examined were defective, which seemed not to be true, this would indicate that a study of the pleural hairs of other species of Old World *Uranotænia* might be of value in grouping the species into subgenera.

GENERAL DISCUSSION

This study was not undertaken with any idea that the pleural hairs would offer characters which would supersede those already in use for the identification of culicine larvæ. The genera of culicine mosquitoes are so well marked, in the larvæ, by the characters of the air tube, pecten, and comb that no further characters are necessary for their satisfactory identification. It was hoped, however, that the pleural hairs might be of assistance in classification; that is, in determining the position of the different genera in a natural evolutionary series. It must be admitted that, in the material examined, no natural series can be traced, in its entirety, although the pleural hairs do offer certain suggestive possibilities.

In order to decide which genera of the Culicinæ are the more primitive, in respect to the pleural-hair characters, it is necessary to decide what characteristics are to be considered primitive. An examination of a few examples of the other subfamilies included by most authorities in the Culicidæ, shows that in most of the genera of the Chaoborinæ (in *Eucorethra*, *Corethra*, and

Chaoborus, at least) the pleural hairs are either absent or cannot be located. In certain species of *Dixa* (subfamily Dixinæ), on the other hand, the prothoracic group contains four very long hairs, the mesothoracic group four short hairs, and the metathoracic group two short hairs, none of them branched.

With a decision based partly on the conditions exhibited by *Dixa* and partly on general theoretical considerations, it may be suggested that, in the first place, unbranched hairs represent a more primitive condition than branched ones; second, that primitively all the pleural hairs were long, as in *Dixa*, and that the shortening of certain hairs represents specialization; and, third that originally each of the three groups had the same composition as the others, so that differences between the different groups are the result of specialization.

In none of the Culicinæ do we find any group of pleural hairs with four hairs of equal length, like the prothoracic and mesothoracic groups of *Dixa*. Hair pd is invariably short or very short in all the forms examined. The most primitive condition as to length of the pleural hairs that one can expect, then, is that in which each group contains three long hairs. This condition is found in *Joblotia* and *Wyeomyia* (*Pentemyia*) *bromeliarum* in the sabethines and in *Megarhinus* and *Psorophora* (*Grabhamia*) among the culicines.

The cases in which all of the long pleural hairs are unbranched are also few in number. They occur in *Chagasia* and the more primitive species of *Anopheles*, also in *Megarhinus* and *Aëdeomyia* (and in *Uranotænia quadrimaculata*) among the culicines. The nearest approach to this condition among the sabethines is in *Wyeomyia* (*Dodecamyia*), which has only a single one of the pleural hairs (III–ad) branched. The fact that this subgenus also exhibits a very simple type of clasper in the male hypopygium, while practically all of the other subgenera of *Wyeomyia*, *Dendromyia*, etc., have very complex and highly modified claspers, suggests that this may really be a primitive group.

The only genera in which all three groups of pleural hairs have essentially the same composition are *Megarhinus* and *Joblotia*.

The evidence from the pleural hairs, then, suggests that *Megarhinus* is the most primitive of all the forms examined. From this point on there appear to be at least three distinct lines of development, one leading through *Chagasia* to *Anopheles* and characterized especially by the presence of only two long hairs

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined.*

PROTHORACIC GROUP OF PLEURAL HAIRS.

Tribe, genus, and species.	I–av.	I–ad.	I–pv.	I–pd.
AMERICAN SPECIES				
Tribe Anophelini				
Genus *Chagasia* Cruz (after Root)	Long, single	Long, single	Long, single	Short.
Genus *Anopheles* Meigen (after Puri and Root)	do	do Long split Long feathered	do	Do.
Tribe Megarhinini				
Genus *Megarhinus* Robineau-Desvoidy:				
M. septentrionalis Dyar and Knab	do	Long stout spinose	do	Do.
M. portoricensis von Roder	do	do	do	Do.
M. trinidadensis Dyar and Knab	do	do	do	Do.
M. neglectus Lutz	do	do	do	Do.
M. purpureus Theobald	do	do	do	Do.
Tribe Culicini				
Culicine group				
Genus *Culex* Linnæus:				
Subgenus *Neoculex* Dyar—				
C. apicalis Adams	Short, single	Short, single	do	Very short.
Subgenus *Culex* Linnæus—				
C. bahamensis Dyar and Knab	do	do	do	Do.
C. duplicator Dyar and Knab	do	do	do	Do.
C. nigripalpus Theobald	do	do	do	Do.
C. chidesteri Dyar	do	do	do	Do.
C. secutor Theobald	do	do	do	Do.
C. mollis Dyar and Knab	do	do	do	Do.
C. salinarius Coquillett	do	do	do	Do.
C. declarator Dyar and Knab	do	do	do	Do.
C. fatigans Wiedemann	do	do	do	Do.

C. pipiens Linnæus	do	do	do	Do.
C. territans Theobald	do	do	do	Do.
C. extricator Dyar and Knab	do	do	do	Do.
C. coronator Dyar	do	do	do	Do.
C. corniger Theobald	do	Fairly long single	do	Do.
Subgenus *Carrollella* Lutz—				
C. bihaicolus Dyar and Nuñez Tovar	do	do	do	Do.
C. iridescens (Lutz)	do	do	do	Do.
Subgenus *Melanoconion* Theobald—				
C. atratus Theobald	do	do	Short single	Do.
C. aikenii (Aiken)	do	do	do	Do.
C. conservator Dyar and Knab	do	do	do	Do.
C. antillum magnorum Dyar	do	do	do	Do.
Subgenus *Microculex* Theobald—				
C. pleuristriatus Theobald	do	Fairly long double	do	Do.
C. chryselatus Dyar and Knab	do	Fairly long single	do	Do.
C. imitator Theobald	do	do	do	Do.
Subgenus *Chœroporpa* Dyar—				
C. inhibitator Dyar and Knab	do	Short single	do	Do.
C. educator Dyar and Knab	do	do	do	Do.
C. innominatus Evans	do	do	do	Do.
C. iolambdis Dyar	do	do	do	Do.
C. elevator Dyar and Knab	do	do	do	Do.
C. phlogistus Dyar	do	do	do	Do.
C. bastagarius Dyar and Knab	do	do	do	Do.
Subgenus *Mochlostyrax* Dyar and Knab—				
C. innovator Evans	do	do	do	Do.
C. hesitator Dyar and Knab	do	do	do	Do.
C. unicornis Root	do	do	do	Do.
C. pilosus Dyar and Knab	do	do	do	Do.
Genus *Deinocerites* Theobald:				
D. cancer Theobald	do	Long, single	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

PROTHORACIC GROUP OF PLEURAL HAIRS—Continued

Tribe, genus, and species.	I–av.	I–ad.	I–pv.	I–pd.
Intermediate group				
Genus *Aëdeomyia* Theobald:				
A. squamipennis (Lynch Arribálzaga)	Long, single	Long, single	Short, single	Very short.
Genus *Mansonia* Blanchard:				
M. humeralis Dyar and Knab	Short, single	Short, single	do	Do.
M. titillans (Walker)	do	do	do	Do
M. indubitans Dyar and Shannon	do	do	do	Do.
Genus *Orthopodomyia* Theobald:				
O. signifera (Coquillett)	Long, single	Long, fan	do	Do.
O. albicosta (Lutz)	do	do	do	Do.
O. fascipes (Coquillett)	do	do	do	Do.
Genus *Theobaldia* Neveu-Lemaire:				
T. inornata (Williston)	do	Long, single	do	Do.
T. dyari (Coquillett)	Short, single	do	do	Do.
T. melanura (Coquillett)	do	do	do	Do.
Aëdine group				
Genus *Aëdes* Meigen:				
Subgenus *Howardina* Theobald—				
A. ioliota Dyar and Knab	Fairly long single	Short stellate tuft	do	Do.
A. buseckii (Coquillett)	do	do	do	Do.
A. fulvithorax (Lutz)	do	Fairly long 4-branched	do	Do.
Subgenus *Finlaya* Theobald—				
A. terrens (Walker)	Long, single	Fairly long triple	do	Do.
A. podographiens Dyar and Knab	do	Short, double	do	Do.
A. triseriatus (Say)	Fairly long single	do	do	Do.
A. atropalpus (Coquillett)	Long, single	Fairly long single	do	Do.
A. fluviatilis (Lutz)	do	do	do	Short, single.
A. mediovittatus (Coquillett)	do	Short triple tuft	do	Short triple tuft.

Subgenus *Ochlerotatus* Lynch Arribálzaga—				
A. tæniorhynchus (Wiedemann)	Fairly long single	Fairly long single	do	Short, single.
A. sollicitans (Walker)	do	do	do	Very short.
A. mitchellæ (Dyar)	do	do	do	Do.
A. canadensis (Theobald)	do	do	do	Do.
A. punctor (Kirby)	do	do	do	Do.
A. cantator (Coquillett)	do	do	do	Do.
A. fulvus (Wiedemann)	do	do	do	Do.
A. atlanticus Dyar and Knab	do	do	do	Do.
A. tormentor Dyar and Knab	do	do	do	Do.
A. scapularis (Rondani)	do	do	do	Do.
A. infirmatus Dyar and Knab	do	do	do	Do.
A. angustivittatus Dyar and Knab	do	do	do	Do.
A. nubilus (Theobald)	do	do	do	Do.
A serratus (Theobald)	do	do	do	Do.
A. tortilis (Theobald)	do	do	do	Do.
A. dupreei (Coquillett)	do	do	do	Do.
A. hastatus Dyar	do	do	do	Do.
Subgenus *Stegomyia* Theobald—				
A. ægypti (Linnæus)	do	do	do	Do.
Subgenus *Aëdimorphus* Theobald—				
A. vexans (Meigen)	do	do	do	Do.
Subgenus *Aëdes* Meigen—				
A. cinereus Meigen	do	Fairly long double or triple	do	Do.
Genus *Psorophora* Robineau-Desvoidy:				
Subgenus *Grabhamia* Theobald—				
P. cingulata (Fabricius)	do	Fairly long single	do	Do
P. columbiæ (Dyar and Knab)	do	do	do	Do.
P. jamaicensis (Theobald)	do	do	do	Do.
P. confinnis (Lynch Arribálzaga)	do	do	do	Do.
P. discolor (Coquillett)	Short single	Short single	do	Do.
Subgenus *Janthinosoma* Lynch Arribálzaga—				
P. cyanescens (Coquillett)	Fairly long double	Long single	do	Do.
P. ferox (Humboldt)	Short single	do	do	Do.
P. lutzii Theobald	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	I–av.	I–ad.	I–pv.	I–pd.
Genus *Psorophora* Robineau-Desvoidy—Continued.				
Subgenus *Psorophora* Robineau-Desvoidy—				
P. lineata (Humboldt)	Fairly long split	Fairly long split	Long split	Very short.
P. cilipes (Fabricius)	do	do	do	Do.
P. howardii Coquillett	do	do	do	Do.
P. ciliata (Fabricius)	do	do	do	Do.
Genus *Hæmagogus* Williston:				
H. splendens Williston	Fairly long single	Short stellate tuft	Long single	Short.
Sabethine group				
Genus *Joblotia* Blanchard:				
J. compressa (Theobald)	Long single	Long 3- or 4-branched	do	Do.
J. digitata (Rondani)	do	do	do	Do.
Genus *Goeldia* Theobald:				
G. lunata (Theobald)	Long double	Long fan	do	Spine.
G. longipes (Fabricius)	Long triple	Long 4- or 5-branched	do	Do.
Genus *Isostomyia* Coquillett:				
I. magna (Theobald)	Long double	Long 3- or 4-branched	do	Do.
Genus *Wyeomyia* Theobald:				
Subgenus *Wyeomyia* Theobald—				
W. longirostris Theobald	Long 2- to 4-branched	Long 2- to 4-branched	do	Very short.
W. quasiluteocentralis (Theobald)	do	do	do	Do.
W. pertinans (Williston)	do	do	do	Do.
W. gaudians Dyar and Nuñez Tovar	do	do	do	Do.
Subgenus *Phyllosomyia* Dyar—				
W. smithii (Coquillett)	do	do	do	Do.
W. celænocephala Dyar and Knab	do	do	do	Do.
Subgenus *Pentemyia* Dyar—				
W. bromeliarum Dyar and Knab	do	do	do	Do.
Subgenus *Nunezia* Dyar—				
W. bicornis (Root)	Long single	Short single	do	Do.

Subgenus *Dodecamyia* Dyar—				
W. quasilongirostris (Theobald)	do	Long single	do	Do.
W. pilicauda Root	do	do	do	Do.
Subgenus *Dinomyia* Dyar—				
W. mystes (Dyar)	Long 2- to 4-branched	Long 2- to 4-branched	do	Spine.
W. bourrouli Peryassú	do	do	do	Do.
Subgenus *Melanolepis* Dyar—				
W. complosa Dyar	Long double	Long fan	Long double	Do.
Subgenus *Heliconiamyia* Dyar—				
W. chalcocephala (Dyar and Knab)	do	Long triple	Long single	Very short.
Subgenus *Calladimyia* Dyar—				
W. melanoides Root	Long 5-branched fan	Long 5-branched fan	do	Do.
Subgenus *Decamyia* Dyar—				
W. pseudopecten (Dyar and Knab)	Long double or triple	Long 4- or 5-branched fan	Long double or triple	Do.
W. felicia Dyar and Nuñez Tovar	do	do	do	Do.
Genus *Limatus* Theobald:				
L. durhamii Theobald	Long double	Long 3- or 4-branched	Long single	Do.
L. asulleptus (Theobald)	do	do	do	Do.
Genus *Sabethoides* Theobald:				
S. purpureus Theobald	Long fan	Long fan	do	Do.
Uranotænia group				
Genus *Uranotænia* Lynch Arribálzaga:				
U. sapphirina (Osten-Sacken)	Long single	Long double	Short single	Do.
U. pulcherrima Lynch Arribálzaga	do	do	do	Do.
U. geometrica Theobald	do	do	do	Do.
U. lowii Theobald	do	do	do	Do.
U. coatzacoalcos Dyar and Knab	do	Long 3- or 4-branched	do	Do.
OLD-WORLD SPECIES				
Lutzia tigripes Grandpré and Charmoy	Fairly long single	Long single	Long single	Do.
Culex (Culex) sitiens Wiedemann	Short single	Short single	do	Do.
Culex (Culex) pacificus Edwards	do	do	do	Do.
Culex (Lophoceratomyia) sp?	do	do	do	Do.
Culex (Lophoceratomyia) sp?	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

PROTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	I-av.	I-ad.	I-pv.	I-pd.
Aëdes (Finlaya) albilabris Edwards	Fairly long single	Short double	Long single	Very short.
Aëdes (Stegomyia) albolineatus Theobald	do	Fairly long stellate tuft	do	Short single.
Aëdes (Stegomyia) variegatus Schrank	do	Fairly long single	do	Short.
Rachionotomyia caledonica Edwards	do	Long fan	do	Very short.
Rachionotomyia sp?	do	do	do	Do.
Uranotænia quadrimaculata Paine and Edwards	Short double	Long single	Short single	Do.

MESOTHORACIC GROUP OF PLEURAL HAIRS.

Tribe, genus, and species.	II-av.	II-ad.	II-pv.	II-pd.
AMERICAN SPECIES				
Tribe Anophelini				
Genus *Chagasia* Cruz (after Root)	Long single	Long single	Short	Very short.
Genus *Anopheles* Meigen (after Puri and Root)	do	do	do	Do.
Tribe Megarhinini				
Genus *Megarhinus* Robineau-Desvoidy:				
M. septentrionalis Dyar and Knab	do	Long stout spinose	Long single	Do.
M. portoricensis von Röder	do	do	do	Do.
M. trinidadensis Dyar and Knab	do	do	do	Do.
M. neglectus Lutz	do	do	do	Do.
M. purpureus Theobald	do	do	do	Do.

Tribe Culicini				
Culicine group				
Genus *Cutex* Linnæus:				
Subgenus *Neoculex* Dyar—				
C. apicalis Adams	do	Long fan	do	Do.
Subgenus *Culex* Linnæus—				
C. bahamensis Dyar and Knab	do	do	do	Do.
C. duplicator Dyar and Knab	do	do	do	Do.
C. nigripalpus Theobald	do	do	do	Do.
C. chidesteri Dyar	do	do	do	Do.
C. secutor Theobald	do	do	do	Do.
C. mollis Dyar and Knab	do	do	do	Do.
C. salinarius Coquillett	do	do	do	Do.
C. declarator Dyar and Knab	do	do	do	Do.
C. fatigans Wiedemann	do	do	do	Do.
C. pipiens Linnæus	do	do	do	Do.
C. territans Theobald	do	do	do	Do.
C. extricator Dyar and Knab	do	do	do	Do.
C. coronator Dyar	do	do	do	Do.
C. corniger Theobald	do	do	do	Do.
Subgenus *Carrollella* Lutz—				
C. bihaicolus Dyar and Nuñez Tovar	do	do	do	Do.
C. irridescens (Lutz)	do	do	do	Do.
Subgenus *Melanoconion* Theobald—				
C. atratus Theobald	do	do	do	Do.
C. aikenii (Aiken)	do	do	do	Do.
C. conservator Dyar and Knab	do	do	do	Do.
C. antillum-magnorum Dyar	do	do	do	Do.
Subgenus *Microculex* Theobald—				
C. pleuristriatus Theobald	do	do	do	Do.
C. chryselatus Dyar and Knab	do	do	do	Do.
C. imitator Theobald	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

MESOTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	II–av.	II–ad.	II–pv.	II–pd.
Genus *Culex* Linnæus—Continued.				
Subgenus *Chæroporpa* Dyar—				
C. inhibitator Dyar and Knab	Long single	Long fan	Long single	Very short.
C. educator Dyar and Knab	do	do	do	Do.
C. innominatus Evans	do	do	do	Do.
C. iolambdis Dyar	do	do	do	Do.
C. elevator Dyar and Knab	do	do	do	Do.
C. phlogistus Dyar	do	do	do	Do.
C. bastagarius Dyar and Knab	do	do	do	Do.
Subgenus *Mochlostyrax* Dyar and Knab—				
C. innovator Evans	do	do	do	Do.
C. hesitator Dyar and Knab	do	do	do	Do.
C. unicornis Root	do	do	do	Do.
C. pilosus Dyar and Knab	do	do	do	Do.
Genus *Deinocerites* Theobald:				
D. cancer Theobald	do	do	do	Do.
Intermediate group				
Genus *Aëdomyia* Theobald:				
A. squamipennis (Lynch Arribálzaga)	do	Long single	Fairly long single	Do.
Genus *Mansonia* Blanchard:				
M. humeralis Dyar and Knab	do	Long 3- to 6-branched	Long single	Do.
M. titillans (Walker)	do	do	do	Do.
M. indubitans Dyar and Shannon	do	do	do	Do.
Genus *Orthopodomyia* Theobald:				
O. signifera (Coquillett)	do	Long fan	do	Do.
O. albicosta (Lutz)	do	do	do	Do.
O. fascipes (Coquillett)	do	do	do	Do.
Genus *Theobaldia* Neveu-Lemaire:				
T. inornata (Williston)	do	do	do	Do.
T. dyari (Coquillett)	do	do	do	Do.
T. melanura (Coquillett)	do	do	do	Do.

Aëdine group				
Genus *Aëdes* Meigen:				
Subgenus *Howardina* Theobald—				
A. ioliota Dyar and Knab	do	do	do	Do
A. busckii (Coquillett)	do	do	do	Do.
A. fulvithorax (Lutz)	do	do	do	Do.
Subgenus *Finlaya* Theobald—				
A. terrens (Walker)	do	do	do	Do.
A. podographicus	do	do	do	Do.
A. triseriatus (Say)	do	do	do	Do.
A. atropalpus (Coquillett)	do	do	do	Do.
A. fluviatilis (Lutz)	do	do	do	Do.
A. mediovittatus (Coquillett)	do	do	do	Do.
Subgenus *Ochlerotatus* Lynch Arribálzaga—				
A. tæniorhynchus (Wiedemann)	do	do	do	Do.
A. sollicitans (Walker)	do	do	do	Do.
A. mitchellæ (Dyar)	do	do	do	Do.
A. canadensis (Theobald)	do	do	do	Do.
A. punctor (Kirby)	do	do	do	Do.
A. cantator (Coquillett)	do	do	do	Do.
A. fulvus (Wiedemann)	do	do	do	Do.
A. atlanticus Dyar and Knab	do	do	do	Do.
A. tormentor Dyar and Knab	do	do	do	Do.
A. scapularis (Rondani)	do	do	do	Do.
A. infirmatus Dyar and Knab	do	do	do	Do.
A. angustivittatus Dyar and Knab	do	do	do	Do.
A. nubilus (Theobald)	do	do	do	Do.
A. serratus (Theobald)	do	do	do	Do.
A. tortilis (Theobald)	do	do	do	Do.
A. dupreei (Coquillett)	do	do	do	Do.
A. hastatus Dyar	do	do	do	Do.
Subgenus *Stegomyia* Theobald—				
A. ægypti (Linnæus)	do	Long double	do	Do.
Subgenus *Aëdimorphus* Theobald—				
A. vexans (Meigen)	do	Long fan	do	Do.
Subgenus *Aëdes* Meigen—				
A. cinereus Meigen	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

MESOTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	II-av.	II-ad.	II-pv.	II-pd.
Genus *Psorophora* Robineau-Desvoidy:				
Subgenus *Grabhamia* Theobald—				
P. cingulata (Fabricius)	Long single	Long fan	Long single	Very short.
P. columbiæ (Dye and Knab)	do	do	do	Do.
P. jamaicensis (Theobald)	do	do	do	Do.
P. confinnis (Lynch Arribálzaga)	do	do	do	Do.
P. discolor (Coquillett)	do	do	do	Do.
Subgenus *Janthinosoma* Lynch Arribálzaga—				
P. cyanescens (Coquillett)	do	do	do	Do.
P. ferox (Humboldt)	do	do	do	Do.
P. lutzii Theobald	do	do	do	Do.
Subgenus *Psorophora* Robineau-Desvoidy—				
P. lineata (Humboldt)	Short split	Long single	Short split	Do.
P. cilipes (Fabricius)	Fairly long double	do	Fairly long single	Do.
P. howardii Coquillett	do	do	do	Do.
P. ciliata (Fabricius)	Short split	do	Short split	Do.
Genus *Hæmagogus* Williston:				
H. splendens Williston	Long single	Long fan	Long single	Do.
Sabethine group				
Genus *Joblotia* Blanchard:				
J. compressa (Theobald)	do	Long 2- to 4-branched	do	Short.
J. digitata (Rondani)	do	do	do	Do.
Genus *Goeldia* Theobald:				
G. lunata (Theobald)	do	Long fan	do	Spine.
G. longipes (Fabricius)	do	do	do	Do.
Genus *Isostomyia* Coquillett:				
I. magna (Theobald)	do	do	do	Do.

Genus *Wyeomyia* Theobald:				
Subgenus *W yeomyia* Theobald—				
W. longirostris Theobald	do	Long double	do	Very short.
W. quasiluteoventralis (Theobald)	do	Long single	do	Do.
W. pertinans (Williston)	do	do	do	Do.
W. gaudians Dyar and Nuñez Tovar	do	do	do	Do.
Subgenus *Phyllozomyia* Dyar—				
W. smithii (Coquillett)	do	Long double	do	Do.
W. celænocephala Dyar and Knab	do	do	do	Do.
Subgenus *Pentemyia* Dyar—				
W. bromeliarum Dyar and Knab	do	do	do	Do.
Subgenus *Nunezia* Dyar—				
W. bicornis (Root)	Fairly long single	Long 4-branched fan	do	Do.
Subgenus *Dodecamyia* Dyar—				
W. quasilongirostris (Theobald)	Long single	Long single	do	Do.
W. pilicauda Root	do	do	do	Do.
Subgenus *Dinomyia* Dyar—				
W. mystes (Dyar)	do	Long double	do	Spine.
W. bourrouli Peryassú	do	Long triple	do	Do.
Subgenus *Melanolepis* Dyar—				
W. complosa Dyar	do	Long 4-branched	do	Do.
Subgenus *Heliconiamyia* Dyar—				
W. chalcocephala (Dyar and Knab)	do	Long triple	do	Very short.
Subgenus *Calladimyia* Dyar—				
W. melanoides Root	do	Long double	do	Do.
Subgenus *Decamyia* Dyar—				
W. pseudopecten (Dyar and Knab)	do	do	do	Do.
W. felicia Dyar and Nuñez Tovar	do	do	do	Do.
Genus *Limatus* Theobald:				
L. durhamii Theobald	do	Long 3 or 4-branched	do	Do.
L. asulleptus (Theobald)	do	do	do	Do.
Genus *Sabethoides* Theobald:				
S. purpureus Theobald	do	Long fan	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

MESOTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	II–av.	II–ad.	II–pv.	II–pd.
Uranotænia group				
Genus *Uranotænia* Lynch Arribálzaga:				
U. sapphirina (Osten-Sacken)	Long single	Long fan	Fairly long single	Very short.
U. pulcherrima Lynch Arribálzaga	do	do	do	Do.
U. geometrica Theobald	do	do	do	Do.
U. lowii Theobald	do	do	do	Do.
U. coatzacoalcos Dyar and Knab	do	do	do	Do.
OLD-WORLD SPECIES				
Lutzia tigripes Grandpré and Charmoy	do	do	do	Do.
Culex (*Culex*) *sitiens* Wiedemann	do	do	do	Do.
Culex (*Culex*) *pacificus* Edwards	do	do	do	Do.
Culex (*Lophoceratomyia*) sp?	do	do	do	Do.
Aëdes (*Finlaya*) *albilabris* Edwards	do	do	do	Do.
Aëdes (*Stegomyia*) *albolineatus* Theobald	do	do	do	Do.
Aëdes (*Stegomyia*) *variegatus* Schrank	do	do	do	Do.
Pachionotomyia caledonica Edwards	do	do	do	Do.
Rachionotomyia sp?				
Uranotænia quadrimaculata Paine and Edwards	do	Long single	Short single	Do.

METATHORACIC GROUP OF PLEURAL HAIRS.

Tribe, genus, and species.	III–av.	III–ad.	III–pv.	III–pd.
AMERICAN SPECIES				
Tribe Anophelini				
Genus *Chagasia* Cruz (after Root)	Long single	Long single	Long single	Very short.
Genus *Anopheles* Meigen (after Puri and Root)	Long single or feathered	Long single or feathered	Short	Do.

Tribe Megarhinini				
Genus *Megarhinus* Robineau-Desvoidy:				
M. septentrionalis Dyar and Knab	Long single	Long stout spinose	Fairly long single	Do.
M. portoricensis von Röder	do	do	do	Do.
M. trinidadensis Dyar and Knab	do	do	do	Do.
M. neglectus Lutz	do	do	do	Do.
M. purpureus Theobald	do	do	do	Do.
Tribe Culicini				
Culicine group				
Genus *Culex* Linnæus:				
Subgenus *Neoculex* Dyar—				
C. apicalis Adams	do	Long fan	Short single	Do.
Subgenus *Culex* Linnæus—				
C. bahamensis Dyar and Knab	do	do	do	Do.
C. duplicator Dyar and Knab	do	do	do	Do.
C. nigripalpus Theobald	do	do	do	Do.
C. chidesteri Dyar	do	do	do	Do.
C. secutor Theobald	do	do	do	Do.
C. mollis Dyar and Knab	do	do	do	Do.
C. salinarius Coquillett	do	do	do	Do.
C. declarator Dyar and Knab	do	do	do	Do.
C. fatigans Wiedemann	do	do	do	Do.
C. pipiens Linnæus	do	do	do	Do.
C. territans Theobald	do	do	do	Do.
C. extricator Dyar and Knab	do	do	do	Do.
C. coronator Dyar	do	do	do	Do.
C. cornigera Theobald	do	do	do	Do.
Subgenus *Carrollella* Lutz—				
C. bihaicolus Dyar and Nuñez Tovar	do	do	do	Do.
C. iridescens (Lutz)	do	do	do	Do.
Subgenus *Melanoconion* Theobald—				
C. atratus Theobald	do	do	do	Do.
C. aikenii (Aiken)	do	do	do	Do.
C. conservator Dyar and Knab	do	do	do	Do.
C. antillum-magnorum Dyar	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	III-av.	III-ad.	III-pv.	III-pd.
Tribe Culicini—Continued				
Culicini group—Continued				
Genus *Culex* Linnæus—Continued.				
Subgenus *Microculex* Theobald—				
C. pleuristriatus Theobald	Long single	Long fan	Short single	Very short.
C. chryselatus Dyar and Knab	do	do	do	Do.
C. imitator Theobald	do	do	do	Do.
Subgenus *Chæroporpa* Dyar—				
C. inhibitator Dyar and Knab	do	do	do	Do.
C. educator Dyar and Knab	do	do	do	Do.
C. innominatus Evans	do	do	do	Do.
C. iolambdis Dyar	do	do	do	Do.
C. phlogistus Dyar	do	do	do	Do.
C. bastagarius Dyar and Knab	do	do	do	Do.
Subgenus *Mochlostyrax* Dyar and Knab—				
C. innovator Evans	do	do	One-half long single	Do.
C. hesitator Dyar and Knab	do	do	do	Do.
C. unicornis Root	do	do	do	Do.
C. pilosus Dyar and Knab	do	do	do	Do.
Genus *Deinocerites* Theobald:				
D. cancer Theobald	do	do	Short single	Do.
Intermediate group				
Genus *Aëdeomyia* Theobald:				
A. squamipennis (Lynch Arribálzaga)	do	Long single	do	Do.
Genus *Mansonia* Blanchard:				
M. humeralis Dyar and Knab	do	Long triple	do	Do.
M. titillans (Walker)	do	do	do	Do.
M. indubitans Dyar and Shannon	do	do	do	Do.

Genus *Orthopodomyia* Theobald:				
O. signifera (Coquillett)	do	Long fan	do	Do.
O. albicosta (Lutz)	do	do	do	Do.
O. fascipes (Coquillett)	do	do	do	Do.
Genus *Theobaldia* Neveu-Lemaire:				
T. inornata (Williston)	do	do	Short double	Do.
T. dyari (Coquillett)	do	do	Short single	Do.
T. melanura (Coquillett)	do	do	Short double	Do.
Aëdine group				
Genus *Aëdes* Meigen:				
Subgenus *Howardina* Theobald—				
A. ioliota Dyar and Knab	do	do	Short single	Do.
A. buschii (Coquillett)	do	do	do	Do.
A. fulvithorax (Lutz)	do	do	do	Do.
Subgenus *Finlaya* Theobald—				
A. terrens (Walker)	do	do	do	Do.
A. podographicus Dyar and Knab	do	do	do	Do.
A. triseriatus (Say)	do	do	do	Do.
A. atropalpus (Coquillett)	do	do	do	Do.
A. fluviatilis (Lutz)	do	do	do	Do.
A. mediovittatus (Coquillett)	do	do	do	Do.
Subgenus *Ochlerotatus* Lynch Arribálzaga—				
A. tæniorhynchus (Wiedemann)	do	do	do	Do.
A. sollicitans (Walker)	do	do	do	Do.
A. mitchellæ (Dyar)	do	do	do	Do.
A. canadensis (Theobald)	do	do	do	Do.
A. punctor (Kirby)	do	do	do	Do.
A. cantator (Coquillett)	do	do	do	Do.
A. fulvus (Wiedemann)	do	do	do	Do.
A. atlanticus Dyar and Knab	do	do	do	Do.
A. tormentor Dyar and Knab	do	do	do	Do.
A. scapularis (Rondani)	do	do	do	Do.
A. infirmatus Dyar and Knab	do	do	do	Do.
A. angustivittatus Dyar and Knab	do	do	do	Do.
A. nubilus (Theobald)	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	III–av.	III–ad.	III–pv.	III–pd.
Aëdine group—Continued				
Genus *Aëdes* Meigen—Continued.				
Subgenus *Ochlerotatus* Lynch Arribálzaga—Ctd.				
A. serratus (Theobald)	Long single	Long fan	Short single	Very short.
A. tortilis (Theobald)	do	do	do	Do.
A. dupreei (Coquillett)	do	do	do	Do.
A. hastatus Dyar	do	Long double	do	Do.
Subgenus *Stegomyia* Theobald—				
A. ægypti (Linnæus)	do	do	do	Do.
Subgenus *Aëdimorphus* Theobald—				
A. vexans (Meigen)	do	Long fan	do	Do.
Subgenus *Aëdes* Meigen—				
A. cinereus Meigen	do	do	do	Do.
Genus *Psorophora* Robineau-Desvoidy:				
Subgenus *Grabhamia* Theobald—				
P. cingulata (Fabricius)	do	do	Fairly long single	Do.
P. columbiæ (Dyar and Knab)	do	do	do	Do.
P. jamaicensis (Theobald)	do	do	do	Do.
P. confinnis (Lynch Arribálzaga)	do	do	do	Do.
P. discolor (Coquillett)	do	do	do	Do.
Subgenus *Janthinosoma* Lynch Arribázaga—				
P. cyanescens (Coquillett)	do	do	Long single	Do.
P. ferox (Humboldt)	do	do	do	Do.
P. lutzii Theobald	do	do	do	Do.
Subgenus *Psorophora* Robineau-Desvoidy—				
P. lineata (Humboldt)	One-half long single	Long single	Short split into 2 or 3	Do.
P. cilipes (Fabricius)	do	do	do	Do.
P. howardii Coquillett	One-half long split into 2 or 3	do	Short split into 3 or 4	Do.
P. ciliata (Fabricius)	do	do	do	Do.
Genus *Hæmagogus* Williston:				
H. splendens Williston	Long single	Long fan	Short single	Do.

Sabethine group				
Genus *Joblotia* Blanchard:				
J. compressa (Theobald)	do	Long 2- to 5-branched	Long single	Do.
J. digitata (Rondani)	do	do	do	Spine.
Genus *Goeldia* Theobald:				
G. lunata (Theobald)	do	Long fan	Short single	Do.
Genus *Isostomyia* Coquillett:				
I. magna (Theobald)	do	do	do	Do.
Genus *Wyeomyia* Theobald:				
Subgenus *Wyeomyia* Theobald—				
W. longirostris Theobald	do	Long double or triple	do	Very short.
W. quasiluteoventralis (Theobald)	do	do	do	Do.
W. pertinans (Williston)	do	do	do	Do.
W. gaudians Dyar and Nuñez Tovar	do	do	do	Do.
Subgenus *Phyllozomyia* Dyar—				
W. smithii (Coquillett)	Long double or triple	do	do	Do.
W. celænocephala Dyar and Knab	Long single	do	do	Do.
Subgenus *Pentemyia* Dyar—				
W. bromeliarum Dyar and Knab	do	Long fan 4- or 5-branched	Long single	Do.
Subgenus *Nunezia* Dyar—				
W. bicornis (Root)	do	Long fan	Short single	Do.
Subgenus *Dodecamyia* Dyar—				
W. quasilongirostris (Theobald)	do	do	do	Do.
W. pilicauda Root	do	do	do	Do.
Subgenus *Dinomyia* Dyar—				
W. mystes (Dyar)	do	Long triple	do	Do.
W. bourrouli Peryassú	do	Long fan	do	Spine.
Subgenus *Melanolepis* Dyar—				
W. complosa Dyar	do	do	do	Do.
Subgenus *Heliconiamyia* Dyar—				
W. chalcocephala (Dyar and Knab)	do	do	do	Do.
Subgenus *Calladimyia* Dyar—				
W. melanoides Root	do	do	do	Spine (branched).
Subgenus *Decamyia* Dyar—				
W. pseudopecten (Dyar and Knab)	do	do	do	Large spine.
W. felicia Dyar and Nuñez Tovar	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	III-av.	III-ad.	III-pv.	III-pd.
Sabethine group—Continued				
Genus *Limatus* Theobald:				
L. durhamii Theobald	Long single	Long 4-branched	Short single	Very short.
L. asulleptus (Theobald)	do	Long 3- or 4-branched	do	Do
Genus *Sabethoides* Theobald:				
S. purpureus Theobald	do	Long fan	do	Do.
Uranotænia group				
Genus *Uranotænia* Lynch Arribálzaga:				
U. sapphirina (Osten-Sacken)	do	do	do	Do.
U. pulcherrima Lynch Arribálzaga	do	do	do	Do.
U. geometrica Theobald	do	do	do	Do.
U. coatzacoalcos Dyar and Knab	do	do	do	Do.
OLD-WORLD SPECIES				
Lutzia tigripes Grandpré and Charmoy	do	do	do	Do.
Culex (*Culex*) *sitiens* Wiedemann	do	do	Short double	Do.
Culex (*Culex*) *pacificus* Edwards	do	do	Short single	Do.
Culex (*Lophoceratomyia*) sp?	do	do	Short triple	Do.
Aëdes (*Finlaya*) *albilabris* Edwards	do	do	Short single	Do.
Aëdes (*Stegomyia*) *albolineatus* Theobald	do	do	do	Do.
Aëdes (*Stegomyia*) *variegatus* Schrank	do	do	do	Do.
Rachionotomyia caledonica Edwards	do	do	do	Do.
Rachionotomyia sp?	do	do	do	Do.
Uranotænia quadrimaculata Paine and Edwards	do	Long single	do	Do.

in the mesothoracic group; another leading through *Joblotia* and *Wyeomyia* (*Dodecamyia*) to the sabethines, characterized by the tendency towards the branching of more than one of the long hairs of the prothoracic group; and the third leading through *Aëdeomyia* to the normal series of culicines (such as *Aëdes*, *Culex*, etc.) and perhaps also to *Uranotænia*.

From the foregoing discussion and from the data previously tabulated regarding the characteristics of the pleural hairs of the various culicine genera it may be clearly seen that, in some cases at least, the variations in the groups of pleural hairs appear to afford some evidence as to the evolutionary position of the different genera. On the other hand, it must also be plainly understood that, in other cases, modifications of the pleural hairs seem to be correlated with the adaptation of the larvæ to unusual types of breeding places.

This may be seen clearly in the genus *Aëdes*, where the normal series of forms, which breed in temporary pools (especially the subgenera *Ochlerotatus* and *Aëdimorphus*) have hair I–ad fairly long and single. The same condition appears in the two species of the subgenus *Finlaya* (*atropalpus* and *fluviatilis*) which breed in rock pools, but in the tree-hole-breeding species of *Finlaya* and in *Howardina* and *Hæmagogus*, which also breed in water held by plants, as a rule, this hair is branched and usually short, sometimes forming a stellate tuft.

In the genus *Culex*, on the other hand, the normal series of forms that breed in permanent pools (subgenera *Culex* and *Chœroporpa* and some species of *Melanoconion*) have both I–ad and I–av short and single, whereas the forms that breed in water held by plants (subgenera *Carrollella* and *Microculex* and some species of *Melanoconion*) have I–ad fairly long. This is also the case in *Culex* (*Culex*) *corniger*, which does not breed in water held by plants but does occupy an unusual breeding place for its subgenus; namely, temporary pools. However, in the subgenus *Mochlostyrax* (also breeding in temporary pools, as a rule) the prothoracic group is of the same type as in the normal series, but hair III–pv of the metathoracic group is unusually long.

The peculiarities of the prothoracic group of pleural hairs in *Orthopodomyia* (I–ad is a long fan) and in the sabethines (I–av and I–ad both usually long and branched from the base) may also be correlated with the fact that these, too, are forms which breed only in water held by various kinds of plants instead of in collections of water on the ground.

SUMMARY

1. The pleural hairs of the larvæ of over one hundred species of American culicine mosquitoes have been examined and a certain number of the Old World species are compared with the related American species; the comparative lengths and types of branching of the hairs are recorded in Table 2 and shown on the plates.

2. From this study it appears that many of the tribes and genera and some of the subgenera of the American culicine mosquitoes are characterized by fairly definite peculiarities of the pleural hairs of the larvæ.

3. Judging by the pleural hairs, *Megarhinus* represents the most primitive type of mosquito, and in the higher forms three different lines of specialization seem to be indicated, resulting in the anophelines, the sabethines, and the *Culex-Aëdes-Uranotænia* complex.

4. In certain cases modifications of the pleural hairs seem to have resulted from the adaptation of the larvæ to unusual types of breeding places. In particular, larvæ which occur normally in water held by plants appear to have the pleural hairs, especially those of the prothorax, more extensively branched than do their relatives that live in collections of water on the ground.

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ILLUSTRATIONS

[I, Prothoracic group; II, mesothoracic group; III, metathoracic group; *a*, anterior dorsal; *b*, anterior ventral; *c*, posterior ventral; *d*, posterior dorsal.]

PLATE 1

FIG. 1. *Megarhinus trinidadensis* Dyar and Knab.
2. *Culex* (*Mochlostyrax*) *pilosus* Dyar and Knab.
3. *Culex* (*Culex*) *fatigans* Wiedemann.
4. *Deinocerites cancer* Theobald.
5. *Aëdeomyia squamipennis* (Lynch Arribálzaga).
6. *Mansonia titillans* Walker.
7. *Orthopodomyia signifera* (Coquillett).

PLATE 2

FIG. 8. *Theobaldia inornata* Freeborn.
9. *Theobaldia melanura* Coquillett.
10. *Aëdes* (*Howardina*) *buskii* (Coquillett).
11. *Aëdes* (*Finlaya*) *podographicus* Dyar and Knab.
12. *Aëdes* (*Ochlerotatus*) *scapularis* (Rondani).
13. *Aëdes* (*Stegomyia*) *ægypti* (Linnæus).
14. *Aëdes* (*Aedimorphus*) *vexans* (Meigen).

PLATE 3

FIG. 15. *Psorophora* (*Grabhamia*) *cingulata* (Fabricius).
16. *Psorophora* (*Janthinosoma*) *ferox* (Humboldt).
17. *Psorophora* (*Psorophora*) *ciliata* (Fabricius).
18. *Lutzia tigripes* Grandpré and Charmoy.
19. *Joblotia digitata* (Rondani).
20. *Goeldia lunata* (Theobald).

PLATE 4

FIG. 21. *Wyeomyia quasiluteoventralis* (Theobald).
22. *Wyeomyia quasilongirostris* Theobald.
23. *Dendromyia complosa* Dyar.
24. *Limatus durhamii* Theobald.
25. *Dendromyia melanoides* Root.
26. *Uranotænia geometrica* Theobald.

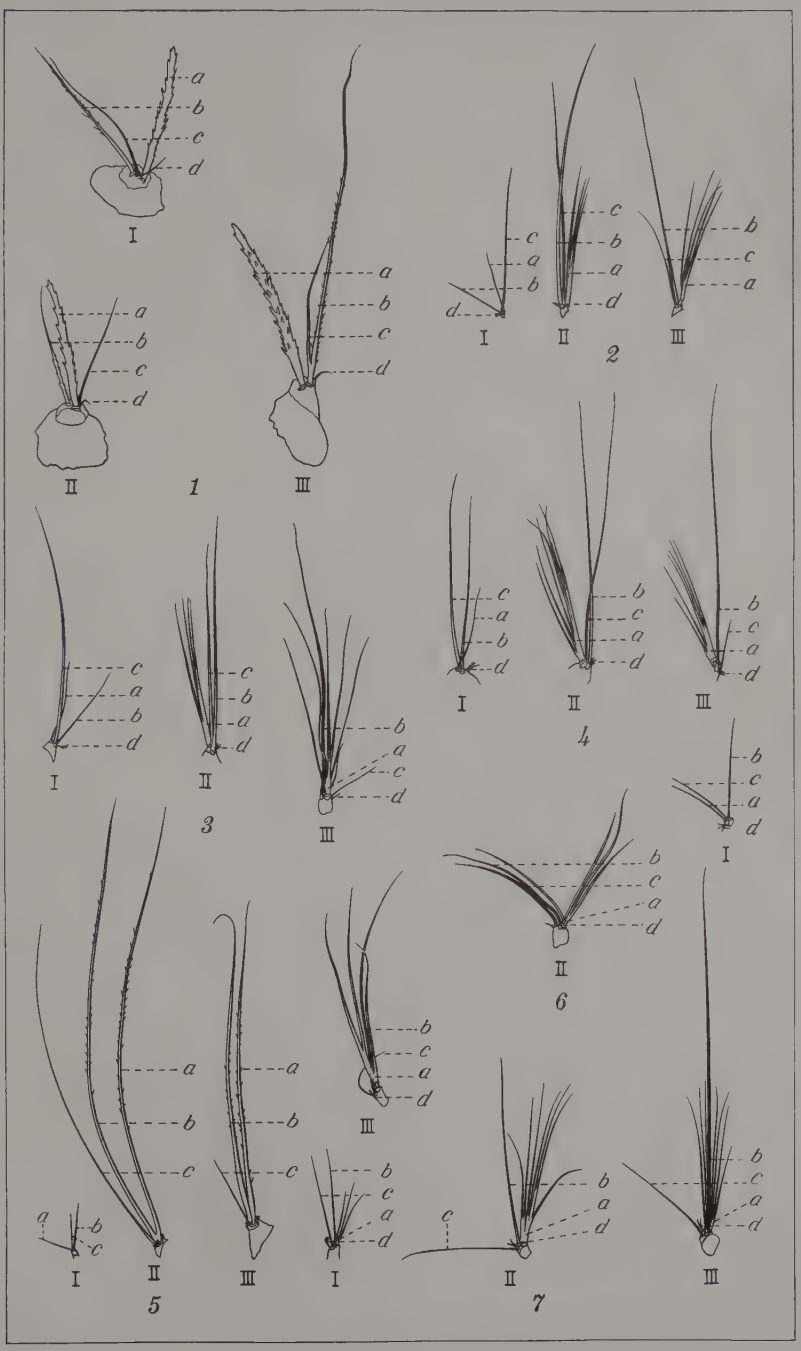
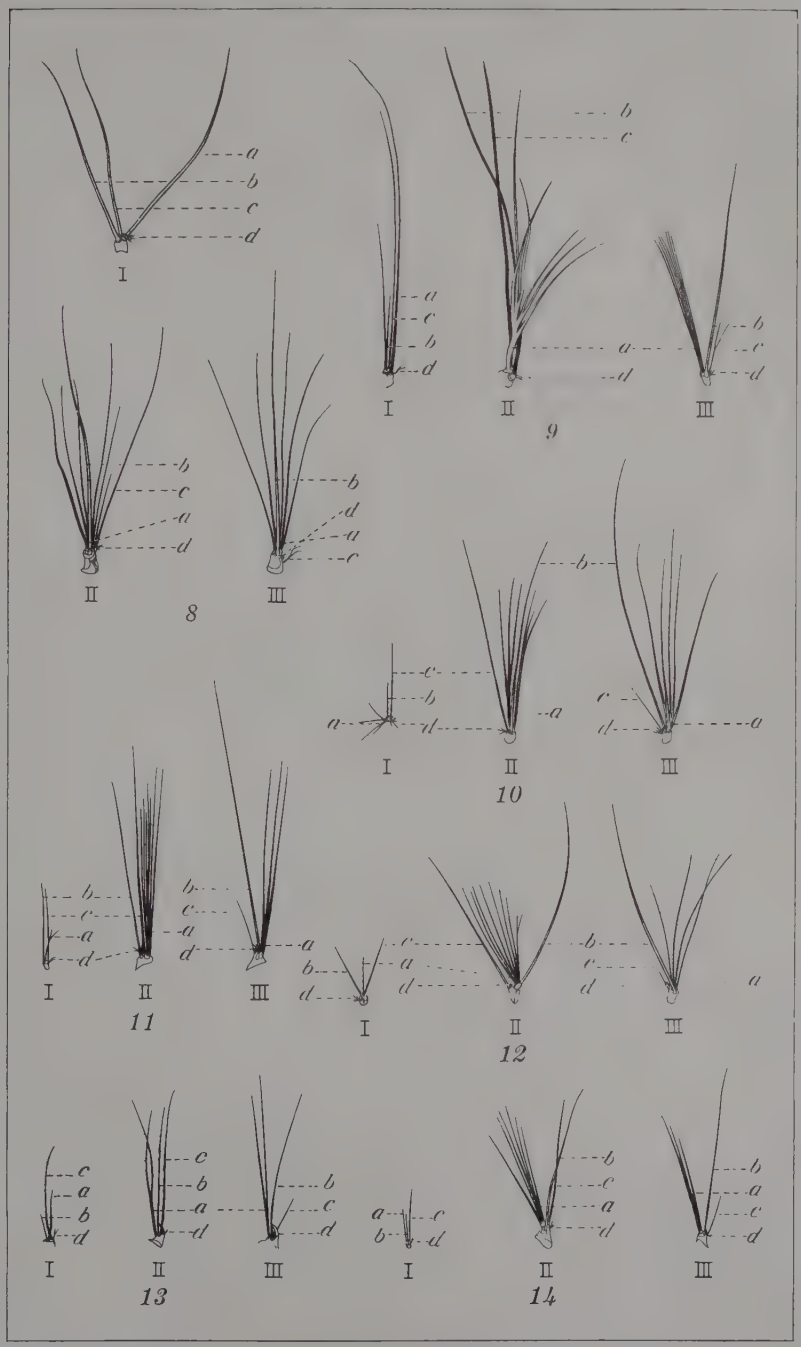


PLATE 1.



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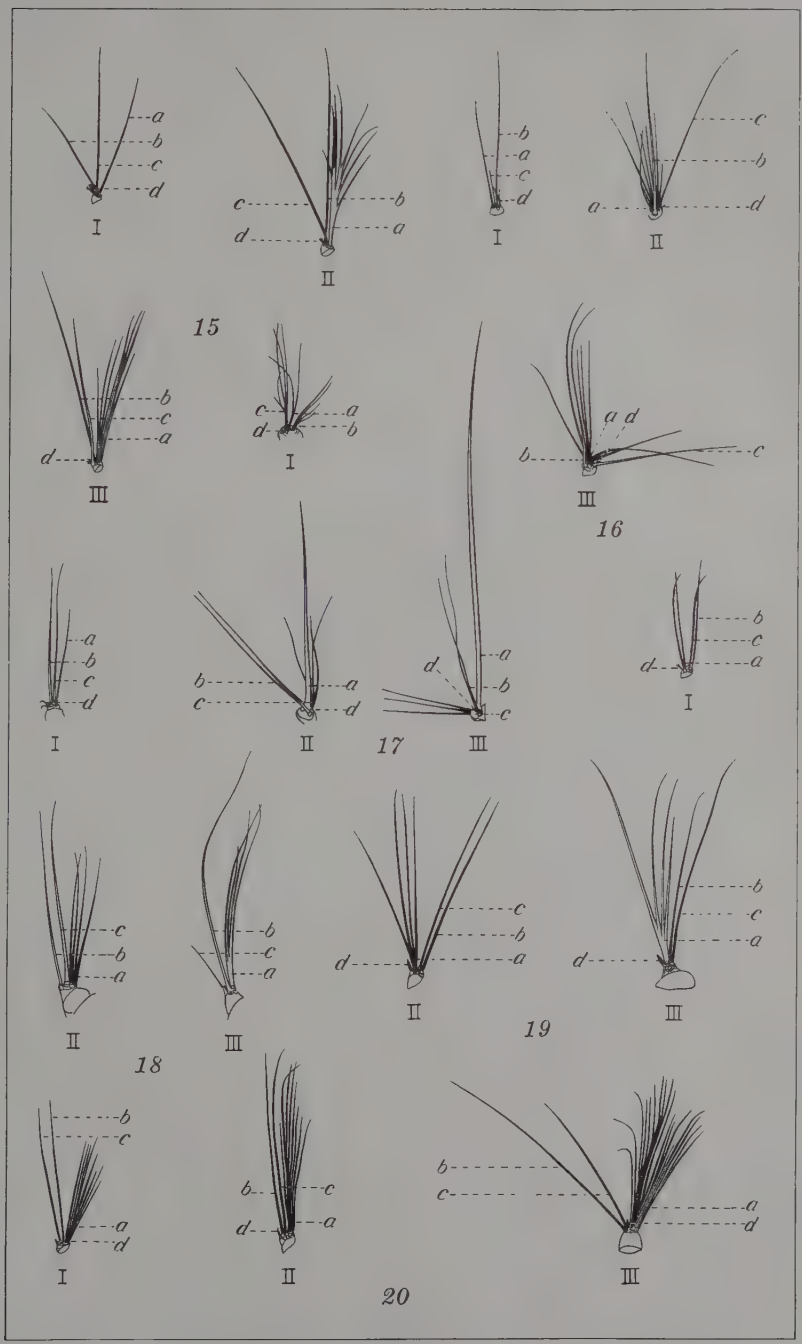
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PLATE 3.

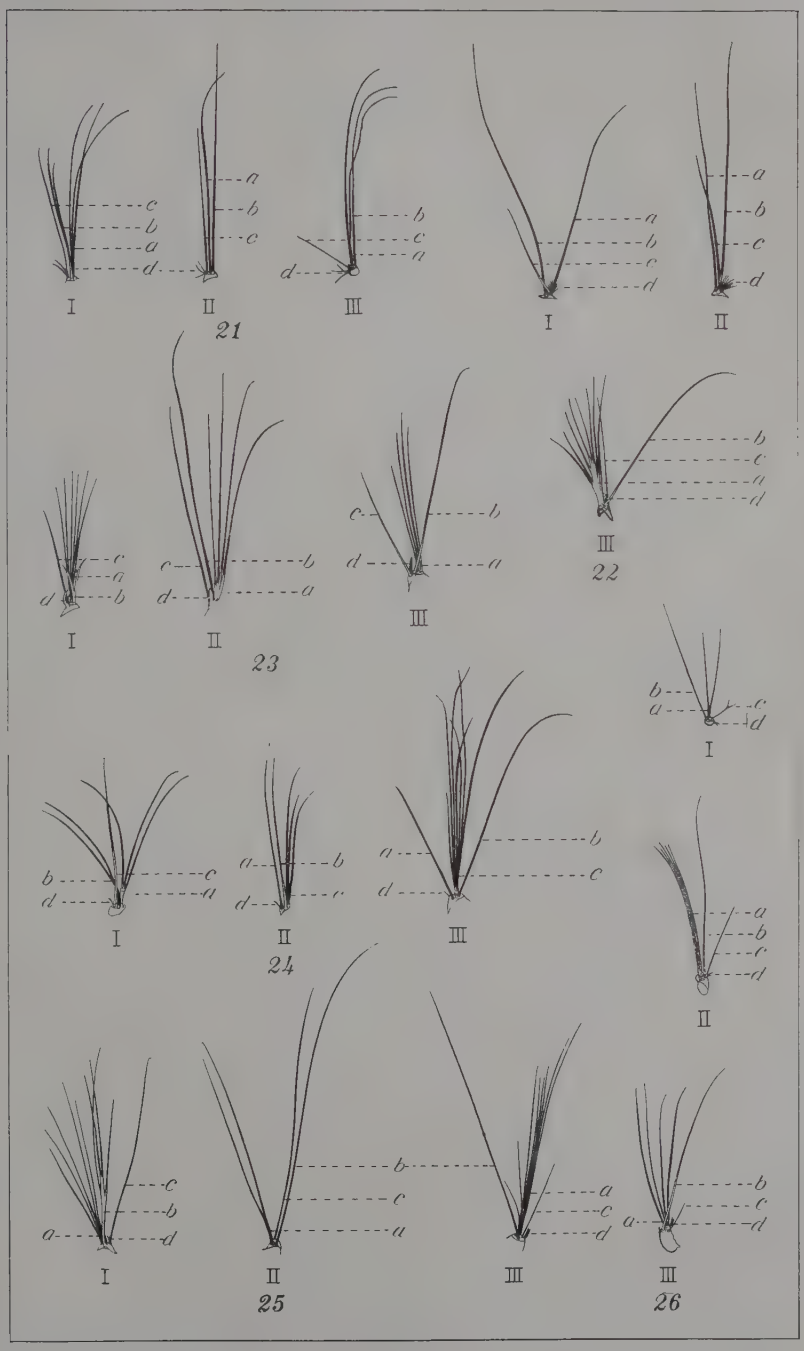

PLATE 4.

CHIRONOMIDÆ FROM JAPAN (DIPTERA), VIII

MARINE OR SEASHORE SPANIOTOMA, WITH DESCRIPTIONS OF THE IMMATURE FORMS OF SPANIOTOMA NEMALIONE SP. NOV. AND TANYTARSUS BOODLEÆ TOKUNAGA.[1]

By Masaaki Tokunaga

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TWO PLATES AND ONE TEXT FIGURE

The chironomid flies discussed here are from the Pacific coast of Kii Peninsula. Larval stages of some species still remain to be found, but I was convinced from the habits of the adults that they must breed in the sea or at least they must be of the haloxenic type.

I am greatly indebted to Prof. Dr. Hachiro Yuasa for his kind direction for the survey of the marine insect fauna. My deepest thanks are also extended to Prof. Dr. Yô K. Okada, director of the Seto Marine Biological Station, of Kyoto Imperial University, for the use of various equipments.

SPANIOTOMA (SMITTIA) LITTORALIS sp. nov.

This minute midge was swarming on the gravelly seashore in great numbers in the evening. Swarming takes place very low, about 100 mm from the surface of the ground, and usually above the zone of the high-tide mark. The immature insects have not been found; probably they hide under the shore drift.

Male.—Body minute, about 1.2 mm long, dull black in general appearance; mouth parts, antennæ, legs, and abdomen brownish black; halteres yellowish white.

Head scantily haired, with only four setæ on vertex behind each eye; frontoclypeus with only six or seven setæ; eyes bare, small, reniform, widely separated from each other on the vertex, distance between them far greater than the vertical length of the eyes (13 : 9) and about 0.6 of the head width. Maxillary palpus 4-segmented (6 : 15 : 17 : 28). Antenna 14-segmented but rarely distal two segments fused, with black plumose hairs;

[1] Contribution from the entomological laboratory of Kyoto Imperial University, No. 52. Contribution from the Seto Marine Biological Laboratory of Kyoto Imperial University.

antennal ratio 0.6 (0.5–0.8); ultimate flagellar segment with short setæ on its distal one-third and a long apical seta, without preapical bare area.

Thorax brown in ground color; pronotum very narrow at dorsomeson, not visible from above, each lateral half with two minute setæ on ventral margin; scutum with three black vittæ; dorsal setæ distinct, suberect, arising from yellow punctures arranged in a double row on the cephalic half and in a single row on the caudal half along the entire length of each pseudosutural fovea; supra-alar setal group represented by six or seven setæ; scutellum dark brown, with six setæ.

Wings (Plate 1, fig. 1) about 1 mm long including squama, milky white by reflected light and hyaline by transmitted light, macrotrichia wanting; squama small, without setæ; anal angle obtuse; marginal setal row of the wing interrupted at the end of vein R_{4+5}. Veins without macrotrichia; costa not produced beyond R_{4+5}; R_{2+3} present, extending close along R_{4+5}, but ending on costa separately from R_{4+5}; R_{4+5} slightly curved cephalad as in the other branches of the radius, ending much before the level of the tip of M_{3+4}; M_{1+2} almost straight; r-m slightly oblique, very short; fCu much beyond the crossvein; M_{3+4} slightly curved downward, atrophied just before the margin; Cu_1 bent downward, very slightly wavy, not reaching the margin; Cu_2 straight, beyond fCu; 1st A straight, short, atrophied far before fCu.

Legs highly setigerous throughout the entire length, the setæ very long especially on femora, tibiæ, and basitarsi of all legs; tibial spurs finely pubescent at base; fore and middle tibiæ each with only one strong spur, without combs; hind tibia with two spurs and a comb which consists of twelve to fourteen free spinules; proximal four tarsal segments each provided with two, short, apical bristles; pulvilli absent; empodium larger than the claws. Relative lengths of the segments of legs, excepting the two proximal segments, as follows: In the foreleg 19.5 : 19.5 : 13.5 : 7 : 4.5 : 3 : 3, in the middle leg 20 : 20 : 11 : 6 : 4.5 : 3 : 3, and in the hind leg 22 : 22 : 14 : 7 : 7 : 3 : 3.

Abdomen scantily haired, with only six or seven pairs of setæ on each tergum, with a black band on the posterior margin of the tergum. Hypopygium (Plate 1, fig. 5) with a pubescent triangular anal point; coxite with a chitinized pubescent lobe on its distomesal end, rarely with another swollen lobe on its distoventral side; ventral thickened ridge of the coxite with six slender setæ; style strongly chitinized, slender, scantily haired, with a small apical bristle.

Female.—Body yellowish brown. Wings broader than in the male; anal angle very obtuse; costa slightly beyond the end of R_{4+5}; dorsal vittæ of the scutum reddish brown, distinctly separated. Antennæ 6-segmented (10 : 17 : 14 : 14 : 12 : 25), each with a small apical seta. Abdomen with brown bands on dorsum; ninth segment with a pair of setigerous, rodlike projections on its lateral side. Other structures as in the male.

Habitat.—Gravelly seashore; Japan.

Holotype.—Male; Seto, Wakayama Prefecture; July 5, 1930.

Allotype.—Female; Ukijima, Mie Prefecture; August 6, 1934.

Paratypes.—Males; Seto, Wakayama Prefecture; July 5, 1930, and Ukijima, Mie Prefecture; August 6, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

According to the taxonomic system of Edwards [2] this species belongs to group E of the subgenus *Smittia;* the general structures closely resemble those of *S.* (*S.*) *curticosta* Edwards and *S.* (*S.*) *trilobata* Edwards, but they are well separated from each other in the structures of the hypopygium. The structures of the wing and the hypopygium are very closely similar to those of *S.* (*S.*) *brevifurcata* Edwards, but the species differ in the color of the halteres, the value of the antennal ratio, and the shape of the styles.

SPANIOTOMA (SMITTIA) NEMALIONE sp. nov.

This small dark midge was colonizing on the algal matting of *Nemalion pulvinatum* and *Endocladia complanata* on the tidal zone of the rocky shore associating with *Clunio tsushimensis* (Tokunaga, 1935, Mushi 8).

Male.—Body about 1.6 mm long, ground color black; antennæ, mouth parts, and scutellum brown; legs and halteres yellowish brown.

Head with about ten setæ on the vertex; eyes reniform, finely pubescent, widely separated from each other, distance between them subequal to the vertical length of the eye (11 : 10) and ratio to head width about 11 : 18; frontoclypeus with only three or four black setæ. Maxillary palpus 4-segmented (10 : 18 : 19 : 33). Antenna 9-segmented; plumose hairs highly reduced, three to five setæ being found on each intermediate flagellal segment; ultimate segment elongated, spindle-shaped, subequal in length

[2] Trans. Ent. Soc. London (1929).

to the preceding three segments taken together, with about three short setæ on the proximal region, without apical bristles; antennal ratio about 0.4 (34 : 83).

Wings (Plate 1, fig. 2) milky white by reflected light and brown by transmitted light, without macrotrichia on the membrane; costal cells, C, Sc, and R_1 fuscous; squama without setæ; anal lobe obtuse. Veins R, R_1, R_{4+5} with macrotrichia; costa produced beyond the end of R_{4+5}, extending more distad beyond the level of the end of M_{3+4}; R_{4+5} long, somewhat swollen, almost straight, closely extending along R_1 and C, ending on costa with a very sharp angle at the opposite side of the end of M_{3+4}; R_{2+3} seemingly absent due to its close contact with R_{4+5} throughout its whole length, as in *Eukiefferiella;* M_{1+2}, M_{3+4}, and Cu_1 atrophied just before wing margin; M_{1+2} almost straight; M_{3+4} almost straight and continuing the direction of the stem; Cu_1 slightly sinuous; 1st A slightly beyond fCu, very slightly curved downward, atrophied far before the wing margin.

Legs without long hairs; foreleg with a strong tibial spur, middle leg with a long and a minute tibial spur, and hind leg with two long tibial spurs accompanied by a small tibial comb which consists of about six free spinules (varying from four to ten); tarsi with small spurlike spinules on the ventral side of each segment; proportional lengths of leg segments, excepting the coxæ and trochanters, as follows: 31 : 38 : 18 : 11 : 7 : 4 : 4 in the foreleg, 39 : 40 : 18 : 9 : 7 : 4 : 4 in the middle leg, and 35 : 38 : 20 : 9 : 9 : 4 : 4 in the hind leg; pulvilli absent; empodium well developed, as long as the claws; claws spatulate and slightly serrate at tip.

Thorax scantily setigerous with about six erect setæ which arise from distinct punctures arranged along pseudosutural fovea; pronotum separated at middle, bare, but rarely with a seta on either lateroventral margin; scutellum brown, with two pairs of black setæ; two or three supra-alar setæ.

Abdomen comparatively setigerous, with short setæ. Hypopygium (Plate 1, fig. 7) with a distinct anal point, which is highly pubescent with black spinules and distinctly clavate in the lateral aspect; coxite stout, with a blunt membranous swelling on the mesal margin; style large, highly pubescent with dark spinules, scantily setigerous on the ventral side, with a small chitinized spine on its tip.

Female.—Body 1.5 to 2 mm long, color as in the male. Frontoclypeus with two pairs of setæ. Antennæ 6-segmented

(10 : 20 : 12 : 12 : 11 : 29); terminal segment with only one seta on its basal region; other intermediate segments each with two long setæ. Pronotum with a seta on either lateral margin; supra-alar setæ three. Wing comparatively broader than in the male, its anal lobe also obtuse; R_{4+5} curved along the costal margin; M_{1+2} slightly sinuous, gradually curved downward on its distal half; M_{3+4} slightly curved downward; Cu_1 strongly bent and sinuous. Relative lengths of leg segments as follows: 23 : 27 : 13 : 7 : 4.5 : 3 : 3.5 in the foreleg, 30 : 32 : 14 : 7 : 5 : 3 : 4 in the middle leg, and 28 : 30 : 15 : 7 : 7 : 3 : 3.5 in the hind leg; tibial comb of the hind leg consisting of about nine spinules, which are longer than the shorter tibial spur. Claws simple, as long as the empodium; pulvilli absent. Abdomen pale brown, appearing dark due to the subcutaneous black pigmental layer; eighth sternum dark on its cephalic half, shallowly concave on its caudal margin, with paired setigerous areas on its caudal part, with paired lobes which are somewhat angulate and pubescent with minute spinules on the caudal margin; ninth sternum, which is separated into lateral small halves by a large median membrane, also black, setigerous with about seven black setæ; cerci (Plate 1, fig. 10) setigerous with long setæ, very small, also black, somewhat pointed on the caudal angle; other parts of the hypopygium pale brown; spermathecæ (Plate 1, fig. 9) two, ovoid, dark brown, but hyaline on basal part and on duct. Other structures closely related to those of the male.

Pupa.—Body 2.5 to 2.8 mm long; exuvia yellowish hyaline; head, thorax, and genital sheaths yellowish brown.

Head without hornlike projections, provided with a pair of small setæ on vertex between antennal bases and another pair on genal part.

Thorax without respiratory horns as in general for marine chironomid pupæ; prothorax with two pairs of long setæ; mesothorax with three pairs of setal groups: One pair composed of one long and two short, closely associated setæ, located on the cephalolateral corners; other pairs composed of two, small, closely associated setæ, located on meson of scutum.

Dorsum of each abdominal segment finely spinulous all over the surface leaving only two pairs of oval clear spots and provided with a spinulous creeping ridge composed of three rows of recurved spinules on caudal margin excepting first abdominal segment; dorsal side with three pairs of setæ or setal groups on each segment: One pair of single setæ on meson of cephalic

part, one pair of single or, rarely, compound setæ on meson of caudal part, and another pair of setal groups, each of which consists of two closely associated setæ on laterocaudal part; dorsal side of first abdominal segment less spinulous than in the other segment, spinules being highly atrophied on meson; on dorsal side of eighth abdominal segment setal pairs retained only on caudal part, being represented by two pairs of simple setæ. Ventral side of each abdominal segment almost smooth and hyaline, provided with a caudal spinulous area composed of many recurved spinules arranged in an oval area, except the two cephalic segments; setal arrangement of venter as follows: One pair of simple setæ on cephalic part and one pair of double setæ on caudal part. Lateral side of each segment also spinulous, provided with a long seta on cephalic part and one or two setæ on caudal part, without lateral swimming expansions. Ultimate segment without setæ; dorsal side flat, somewhat square but slightly narrowed basally, provided with two minute points on either side of the posterior corners; in male dorsal side more elongated and more spinulous than in the female; genital sheaths distinctly protruded caudad beyond the caudal margin of the tergal plate in male, while in female they are very short, not visible from above (Plate 2, figs. 12 and 13).

Larva.—Body about 4.2 mm long in full-grown stage; head dark brown; thorax and abdomen purplish black due to the subcutaneous layer of pigment; anal gills wanting.

Head with large black eyespots on the pale areas; each eyespot consists of a large, oval, dorsal pigment granule and one or two small ventral granules; front comparatively broad, with two pairs of setæ on the lateral margin of the cephalic part; each half of the vertex with two sensory pores along the stem of the epicranial suture, an isolated seta and a sensory pore along the epicranial arm, a seta and two sensory pores near the base of antenna, a sensory pore near the eyespot, two setal groups, each of which consists of two setæ, on ventrocephalic part. Clypeus thinly and uniformly chitinized, with three pairs of slender setæ on its margin; labrum membranous, with various appendages: One pair of slender and one pair of strong nonserrate bristles on the meson, two pairs of minute sensillæ laterad of these bristles, one pair of small median and one pair of large, lateral, comblike or featherlike appendages on the meson closely along the labraliæ, several (four large and two small) trichoid appendages on the lateral side. Epipharynx with one pair of small, and three pairs of strong, clawlike appendages close to each other

on the meson; four setæ on the V-shaped chitinization of epipharynx; one large and one small oval chitinization just caudad of V-shaped thickening; premandibles (Plate 2, fig. 18) each with one minute and two distinct teeth. Antenna (Plate 2, fig. 14) very small, 5-segmented, with a large sensory pore, two minute setæ and two large trichoid sensillæ on proximal segments; a clavate hyaline sensilla on second segment. Mandible comparatively slender, with five distinct teeth, a short hyaline bristle, which does not extend to tip of the most proximal tooth, and large plumose hairs (Plate 2, fig. 15) on inner side; suprabrustia wanting. Maxilla (Plate 2, fig. 16) almost hyaline; lacinia fringed with strong projections, with four sensory pegs; maxillary palpus double in structure, crowned with minute sensory appendages. Mentum (Plate 2, fig. 17) with a broad median tooth, flanked by four lateral teeth at either side, with a pair of setal tufts, each of which consists of three setæ, as in *Spaniotoma pacifica* (Saunders). Hypopharynx with a pair of serrate bristles, two or three pairs of sensory pegs, and several conical projections on the distal margin of its membranous lobe and many comblike spinules which extend inward on minute ridges on dorsal membrane of hypopharynx.

Each thoracic segment provided with two pairs of distinct setal groups on the venter; other setæ very slender and obscure; prothoracic pseudopods shallowly bilobate, studded with many thornlike claws, of which distal longer ones are finely serrate. Paired preanal setal tufts each composed of two long setæ growing directly from the integument; one pair of anal setæ on lateral side of anus; posterior pseudopods comparatively small, widely separated from each other, crowned with sixteen claws on each tip; all claws simple, nonserrate, arranged in three rows.

Habitat.—Algal matting of *Nemalion* and *Endocladia,* rocky shore of tidal zone; Japan. The food of the larvæ is largely sedentary diatoms.

Holotype.—Male; Seto, Wakayama Prefecture; April 15, 1934.

Allotopotype.—Female; April 15, 1934.

Paratypes.—Males and females; Seto, Takashiba, and Yukawa, Wakayama Prefecture; April 10 to 15, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species somewhat resembles species of the subgenus *Eukiefferiella* in the venation of the wing, especially of the male, but belongs to group B of the subgenus *Smittia* taken in con-

nection with other characters. A Canadian marine species, *Spaniotoma clavicornis* (Saunders), may be allied to the present species, but the two are easily distinguished by the characteristic structures of the male hypopygium. Another marine midge, *S.* (*Smittia*) *thalassophila* (Goetghebuer), is also related to the present fly, but the compound eyes are not pubescent and the ultimate segment of the male antenna is comparatively long.

The pupa of the present species is somewhat similar in appearance to that of the *halophilus*-group of *Trichocladius* Kieffer [3] in the absence of prothoracic respiratory horns and the spinulous dorsum of the abdomen. More intimate relation is shown among the marine species of the *Camptocladius* group of *Spaniotoma* Philippi.[4] Of the latter group *Spaniotoma pacifica* and *S. clavicornis* are the most similar to the present pupa, except in the slightly different structures of the ultimate tergum and the hyaline spots of the dorsal side.

The larva is also related to the marine forms of the *Camptocladius*-group, but may be distinguished by the number of teeth of the mandible, the setæ of the mentum, and the structure of the infrabrustia of the mandible.

SPANIOTOMA (SMITTIA) BIFURCATA sp. nov.

This is a small black midge found swarming on a gravelly tidal zone.

Male.—Body about 1.65 mm long; wing about 1.06 mm long. Thorax black; abdomen, head, antennæ, maxillary palpi, legs, and stems of halteres dark brown; knobs of halteres yellowish white.

Compound eyes bare; antennæ 14-segmented; antennal plume brown; distal segment with a small apical seta, pubescent apically, comparatively long, as long as the preceding eight segments taken together; antennal ratio about 0.7 (13 : 18).

Pronotum reduced, not visible dorsally. Wings (text fig. 1, *a*) almost hyaline by transmitted light, without macro- or microtrichia on the membrane; squama bare; anal lobe of wing obtuse; majority of veins reaching wing margin; costa not produced beyond tip of R_{4+5}; R_{4+5} ending slightly before the level of the end of M_{1+2}; R_{2+3} extending close along R_{4+5}, ending far

[3] Potthast, Arch. Hydrobiol. Supp.-Bd. (1915) 2; and Alverdes, Zeit. wiss. Ins.-Biol. (1911) 7.

[4] Saunders, Ann. Ent. Soc. Am. (1928) 21.

beyond middle between tips of R_1 and R_{4+5}; stem of Cu_1 very long, extending distad far beyond level of r-m; distal section of Cu_1 almost straight; Cu_2 forked, beyond level of r-m; Cu_{2b} straight; 1st A atrophied near base of fork of Cu_2. Legs setigerous, with brown setæ; pulvilli atrophied; empodium very slender, hardly as long as claws; claw minutely pectinate at truncate tip.

Abdomen setigerous with brown setæ; hypopygium (text fig. 1, *b*) with long, thickly chitinized styles; coxite with an elon-

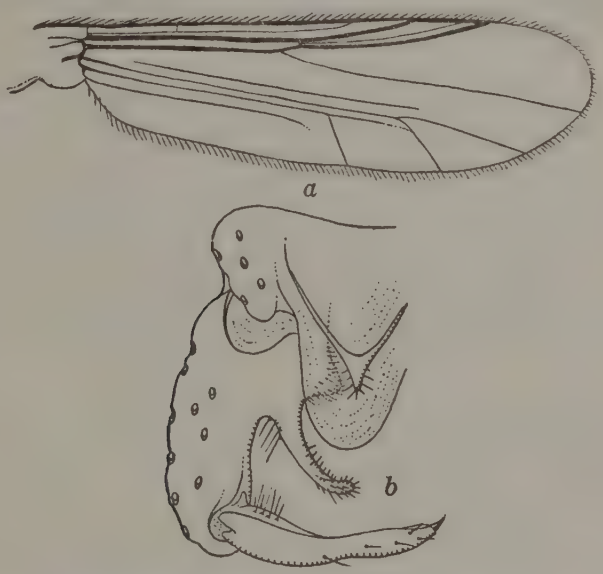

FIG. 1. *Spaniotoma* (*Smittia*) *bifurcata* sp. nov., male; *a*, wing; *b*, hypopygium.

gated distal and a blunt proximal projection on its dorsomesal margin; anal point thickened, with minute setæ on ventral side; anal tube large, distinctly projecting caudad, without setæ.

Habitat.—Tidal zone of gravelly shore, Japan.

Holotype.—Male; Masaki, Mie Prefecture; August 11, 1934.

Paratopotypes.—Males; August 11, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species closely resembles a European marine midge, *S.* (*S.*) *brevifurcata* Edwards, especially in the structure of the wing, but distinctly differs in the color of the halteres, the an-

tennal ratio, and the characteristic structures of the male hypopygium.

SPANIOTOMA (SMITTIA) ENDOCLADIÆ sp. nov.

This small black midge was found on the algal mats of *Endocladia complanata* and *Nemalion pulvinatum* on the upper tidal zone of rocky shores, and males were usually swarming low over the shore. The summer form is far smaller than the spring form, being about two-thirds the size of the latter.

Male.—Body length about 1.8 mm in the spring form and 1.2 mm in the summer form; ground color dull black; halteres dark brown.

Head setigerous; eyes densely pubescent with short hairs, reniform, widely separated from each other; distance between them greater than the vertical diameter of the eyes (14 : 11); frontoclypeus setigerous with many black setæ. Maxillary palpi 4-segmented (10 : 25 : 28 : 40); antennæ plumose, 13-segmented; terminal segment with one apical seta in addition to three basal setæ, not crowned with apical pubescence, shorter than the preceding three segments taken together (34 : 40), but longer than the two segments taken together (34 : 26); antennal ratio about 0.2.

Pronotum larger, not incised at dorsomeson, with two or three fine setæ on either lateral margin; pseudosutural fovea setigerous with about six erect setæ, which arise from large hyaline punctures of the integument; supra-alar setæ three; scutellum with two pairs of black setæ; postscutellum with a brown median stripe.

Wings (Plate 1, fig. 3) slightly brown under transmitted light, without macrotrichia on the membrane; squama bare; anal lobe obtuse. Protrusion of the costa indistinct; R_{2+3} extended close along vein R_{4+5}, ending on costa not far separated from the end of R_{4+5}; straight, ending slightly before the level of the end of M_{3+4}; r-m very short, slightly oblique; M_{1+2} very slightly bent caudad; fCu well beyond the crossvein; M_{3+4} almost straight; Cu_1 distinctly bent caudad at middle; 1st A short, atrophied under fCu.

Legs scantily setigerous with short setæ; proximal four tarsal segments of each leg provided with paired apical spurs; foreleg with bare tibial spur; middle leg with only one tibial spur; tibial comb of hind leg consisting of eight loosely arranged spinules; claws spatulate and finely serrate into four teeth at tip; pulvilli present but very small; relative lengths of

the segments of legs as follows: 27 : 33 : 17 : 12 : 8 : 4 : 4 in the foreleg, 34 : 35 : 18 : 9 : 7 : 4 : 4 in the middle leg, and 32 : 35 : 20 : 10 : 9 : 4 : 4 in the hind leg.

Abdomen slender; hypopygium (Plate 1, fig. 6) setigerous; ninth tergum separated by a median membrane into lateral halves, scantily setigerous on its caudal end; coxite slender, with a distinct basal projection and a mesal concavity; style broad, with a strong terminal spine.

Female.—Body slightly shorter than in the male, dark brown in general appearance. Antennæ 6-segmented (13 : 28 : 16 : 15 : 17 : 31); terminal segment with only one apical seta; maxillary palpi 4-segmented (10 : 21 : 26 : 43). Proportional lengths of the segments of legs as follows: 23 : 29 : 15 : 8 : 6 : 3 : 3 in the foreleg, 33 : 35 : 28 : 8 : 6 : 3 : 3 in the middle leg, and 30 : 33 : 16 : 7 : 7 : 3 : 3.5 in the hind leg; fourth tarsal segment of the hind leg slightly shorter than fifth (17 : 20); claws simple. Wings broader than in the male; cells R_1 and R_{2+3} slightly fuscous; vein R_{2+3} indistinct, closely extending along the slightly swollen R_{4+5}. Cercus somewhat triangular in lateral aspect, setigerous with long setæ, its dorsal angle distinct; ultimate sternum highly setigerous on its caudal area along the U-shaped incision. Other structures closely resembling those of the male.

Habitat.—Upper tidal zone of rocky shore, Japan.

Holotype.—Male; Seto, Wakayama Prefecture; April 19, 1934.

Allotopotype.—Female; April 19, 1934.

Paratypes.—Males and females; Yukawa and Seto, Wakayama Prefecture; June 22, 1930, and April 7 to 19, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species may belong to group B of the subgenus *Smittia* because of the pubescence of compound eyes, although it does not agree satisfactorily with other members of this group in the venation of the wings and the presence of the vestigial pulvilli. The species closely resembles *Spaniotoma marina* (Saunders), but differs in the structures of the male hypopygium and spermathecæ and in the color of the halteres. In the structures of the wing and male hypopygium the present species is closely similar to *Cricotopus fucicola* Edwards, but distinctly different in important generic characters: Thoracic notal setæ erect and arising from large, hyaline punctures squama of wing without setæ, and R_{2+3} ending distinctly beyond the middle between R_1

and R_{4+5}; and the female of the present species is provided with 6-segmented antennæ, differing from the 7-segmented antennæ of the latter species and moreover different in the color of the halteres, the relative lengths of the segments of legs, and the value of the male antennal ratio.

SPANIOTOMA (PSECTROCLADIUS) YUKAWANA sp. nov.

This yellow species was running on the gravelly seashore of an oyster bed and also collected at light ashore.

Male.—Body 2.4 to 2.8 mm long, ground color yellow; scutum with four black vittæ, middle pair yellowish brown or deep yellow in some cases; postscutellum black on its caudal half, with a yellow median line; venter of mesothorax brown or yellowish brown; pleuron of mesothorax with a black spot near wing base in some cases; each abdominal segment with a black median marking on tergum; forelegs brown; tarsal segments of middle and hind legs also brown.

Head yellowish white; eyes bare, reniform, widely separated from each other; distance between them greater than vertical diameter of eye (16 : 12) and equal to 0.57 of head width; frontoclypeus and vertex setigerous with short yellow setæ. Maxillary palpus 4-segmented (22 : 35 : 35 : 40); second segment of palpus with a sensory disc consisting of a group of hyaline trichoid sensillæ; antenna not plumose, 11-segmented, but the constrictions between the flagelial segments obscure and the four segments from seventh to tenth appear to be fused; each segment with three short setæ; terminal segment with an apical seta, somewhat longer than the pedicel (33 : 30) and slightly shorter than the preceding five segments taken together (33 : 36); antennal ratio about 0.38 to 0.39.

Pronotum distinct, with a large median, V-shaped incision, setigerous all over; pseudosutural foveæ setigerous with suberect yellow setæ; scutellum highly setigerous; supra-alar setæ seven.

Legs without long setæ, comparatively stout; claws simple; pulvilli very large, padlike, as long as the claws; empodium slender, slightly longer than the claws; tibial spurs large, pubescent basally, one on the fore tibia, two on each tibia of middle and hind legs; comb of hind tibia consisting of about fifteen large spines, which are longer than the shorter tibial spur; fore tarsal segments without apical spurs; proximal two tarsal segments of middle and hind legs each with strong, paired, apical spurs. Proportional lengths of the segments of legs as follows: 63 : 67 : 36 : 21 : 15 : 10 : 8 in the foreleg, 59 : 61 : 22 : 14 : 10 : 7 : 6

in the middle leg, and 68 : 75 : 38 : 21 : 17 : 9 : 7 in the hind leg.

Wings (Plate 1, fig. 4) comparatively broad, without macrotrichia on the membrane, brown under transmitted light; veins R, R_1, and R_{4+5} setigerous; squama entirely fringed with yellow setæ; anal lobe obtuse. R_{2+3} ending slightly before the middle between the ends of R_1 and R_{4+5}; R_{4+5} almost straight; costa produced beyond the tip of R_{4+5}; r-m oblique; M_{1+2} almost straight, ending at tip of wing; fCu beyond level of r-m; M_{3+4} straight, continuing the direction of the stem, ending on wing margin at opposite side of the end of R_{4+5}; Cu_1 almost straight; 1st A slightly beyond fCu. Halteres yellow.

Abdomen with short yellow setæ, those of tergum arising from distinct hyaline punctures of the integument; hypopygium (Plate 1, fig. 8) with distinct anal point; coxites without mesal lobes; styles slender, scantily setigerous, each with a small black bristle on its tip.

Female.—Body 2.8 to 3 mm long, ground color yellowish white; thoracic vittæ paler than in male, largely yellow; abdominal marking yellowish brown. Head white; distance between compound eyes on vertex far greater than vertical length of eyes (15 : 11) and 15 : 26 in ratio to head width; maxillary palpus 4-segmented (20 : 33 : 34 : 39); antennæ usually 6-segmented (14 : 35 : 18 : 20 : 16 : 30) and at most 8-segmented (14 : 22 : 16 : 18 : 20 : 16 : 11 : 21), in the former case second and third, and seventh and eighth, respectively, are fused; each flagellar segment with three or five setæ besides long, hyaline, trichoid sensillæ; ultimate segment with an apical seta. Thorax more setigerous than in the male. Vein R_{4+5} slightly curved along costal margin; M_{3+4} also very slightly curved; Cu_1 slightly sinuous; 1st A well beyond fCu; and lobe larger than in male. Legs provided with large pulvilli, as in male; relative lengths of the segments as follows: 58 : 64 : 35 : 20 : 14 : 9 : 7 in the foreleg, 55 : 58 : 20 : 12 : 9 : 6 : 6 in the middle leg, and 63 : 74 : 37 : 19 : 16 : 8 : 7 in the hind leg. Hypopygium yellow; eighth sternum with a large U-shaped caudal incision, setigerous on its caudal region; spermathecæ two, large, completely spherical; cerci (Plate 2, fig. 11) yellow, comparatively small, discoidal, setigerous. Other structures as in the male.

Habitat.—Seashore; Japan.

Holotype.—Male; Yukawa, Wakayama Prefecture; April 12, 1934.

Allotopotype.—Female; April 12, 1934.

Paratopotypes.—Males and females; April 11 and 12, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species somewhat resembles the *Orthocladius* group in general appearance, but the large padlike pulvilli present a character of the *Psectrocladius* group. Another group, *Hydrobaunus* Fries, shows structures similar to those of the present species in the absence of the plumose hairs of the male antennæ and the absence of the basal appendages of the coxite, but differs in the short fourth tarsal segments, which are shorter than the fifth. The present species is distinct among the known species of *Psectrocladius* in the small value of the antennal ratio, the less-segmented and nonplumose antennæ of the male, and the absence of mesal lobes of the male hypopygium.

TANYTARSUS BOODLEÆ Tokunaga.

Tanytarsus boodleæ TOKUNAGA, Philip. Journ. Sci. 51 (1933) 358–360.

The immature forms, both larvæ and pupæ, are closely similar in structure to those of *T. halophilæ* Edwards (1926) and are distinctly different from the majority of this genus described by Bause (1913) in the absence of the prothoracic respiratory horns of the pupa, and the incomplete development of the antennal base, abdominal plumose setæ, and anal gills of the larva.

Pupa.—Body about 3 mm long; exuvia hyaline, head, thorax, and hypopygium yellow.

Head with paired brown setæ on the vertex; basal portion of antennal sheath forming a papiliform, hornlike projection. Thorax without trace of thoracic respiratory horns; thoracic integument not imbricate, scantily setigerous; a pair of small setæ on cephalic margin of pronotum, a setal group consisting of a long and a fine bristle on the laterocephalic part where the respiratory horn would be expected, a very long and one or two short setæ on the lateral side before wing base, two closely associated setæ on cephalomeson of scutum, long and short, closely associated setæ on caudoscutal part and a few, scattered, sensory pores and minute sensillæ; two or three minute tubercles on cephalic part of pseudosutural fovea.

Abdominal ornamentation consisting of pairs of small, round, dorsal, spinulous spots on second to sixth segments and paired lateral streaks of chitinization on first to eighth segments; all

dorsal spinulous spots subequal in size; transversal spinulous ridge of second abdominal segment extending straight along entire caudal margin of tergum, composed of a single row of recurved hooklets; lateral swimming lobes not distinct except for those of ultimate two segments; second segment with small, paired, lateral swellings each with a seta. Typical arrangement of abdominal setæ as follows: On dorsal side one pair on meson caudad of paired spinulous spots, one pair on lateral side of caudal part, and one pair on caudal margin; on ventral side two pairs on lateral side of middle part and one pair on caudal margin and on each lateral side one seta on dorsocephalic part, one on ventrocephalic and one on ventrocaudal part. Eighth segment provided with long setæ and in female its sternum forming small, double, caudal lobes; setal arrangement as follows: A pair of small setæ on caudal part of either side of venter and dorsum, a pair of long setæ on each caudal margin of sternum and tergum and on the lateral lobe a long seta on dorsum and three very long setæ on venter; structure of spinulous combs of eighth segment, which are found on the laterocaudal corners, highly different from those of the allied marine species, *T. halophilæ* and *T. maritimus*, spines being fused into a chitinization which is bluntly serrate into two or three teeth (Plate 2, fig. 19). Ultimate segment with large swimming paddles each of which is fringed with about forty long flattened setæ and with two very long dorsal setæ; dorsum of this segment without chitinized tubercules and instead of these tubercules with a pair of small swellings of hyaline integument; genital sheaths in male extending caudad far beyond caudal margin, in female these extend caudoventrad slightly beyond caudal margin of eighth segment.

Larva.—Full grown form about 5 mm long; greenish white in life.

Head brown, oval; two, small, black, spherical eyespots on either side, subequal to and distinctly separated from each other; front elongate, with two pairs of slender setæ on lateral side of cephalic part; each lateral half of vertex with three slender setæ on laterocephalic part and with three sensory pores—one on caudodorsal, one on cephalodorsal, and the other on laterocephalic part—postclypeus thickened, narrow, with a pair of slender setæ; preclypeus also thickened, somewhat trapezoid, with two pairs of long setæ, posterior pair on lateral membrane and anterior pair on thickened plate; clypealiæ, tormæ, and

labraliæ of usual form; labrum hyaline, with many marginal appendages: A pair of minute setæ along cephalic margin of preclypeus, two large comblike appendages (Plate 2, fig. 22, *a*) articulated on a common basal thickening on meson, a pair of long appendages finely fringed and spatulate at tip on meson or dorsad of the former comblike appendages, five pairs of slender spatulate appendages and two pairs of simple, small, accessory appendages on the lateral side; at apex of labrum another chitinized comb (Plate 2, fig. 22, *b*); epipharynx also provided with various appendages: Small paired combs (Plate 2, fig. 22, *c*) on meson of cephalic area, three closely associated simple spines and two plumose spines along arm of V-shaped median thickening (Plate 2, fig. 22, *d*). Premandible (Plate 2, fig. 24) with five flattened teeth, and a fleshy pubescent projection on its mesal side. Antennæ (Plate 2, fig. 23) 5-segmented (20 : 5–7 : 4–5 : 4–4.5 : 1.5); proximal segment with a large sensory pore at base, a sensory hair on the dorsal side, and a biramous, hyaline, trichoid sensilla on apex; other segments without these structures. Mandibles each with five teeth; distadentis slightly smaller than the adjacent largest tooth; a sharp, hyaline, spinelike projection along distal side of first tooth; a hyaline seta arising from base of distadentis and extending as far as tip of mandible; suprabrustia consisting of about eight strong setæ arranged in a single row; infrabrustia composed of finely serrate setæ; two large ordinary setæ and a large sensory pore arranged in the usual positions. Maxillæ (Plate 2, fig. 20) membranous, each with two very long setæ, the setæ on a common basal thickening on maxacoria; lacinial lobe with many sensory appendages; maxillary palpus 3-segmented; two slender setæ and four sensillæ near base of palpus. Mentum (Plate 2, fig. 21) with a large triangular median tooth which carries a small denticle on either side and four pairs of lateral teeth of which the first teeth are very large, subequal in size to the median tooth; lateral lamellæ of the mentum very large, narrowly extended straight laterad, not fanlike in shape; a pair of strong bladelike setæ on base of mentum.

Thorax scantily setigerous with very slender setæ; prothoracic pseudopods distinctly bilobed, studded with numerous yellow hooklets on ventral side; hooklets not fringed or serrate; paired setal groups composed of two or three, distinct, closely associated bristles on ventromeson of each thoracic segment.

Each abdominal segment with comparatively large setæ on lateral side; a double seta (Plate 2, fig. 25) located on caudal part of each lateral side from second to fifth segments, these setæ not plumose, differing from the study of Bause; each preanal dorsal tubercle with eight long setæ on apex and two small setæ on lateral side; one anal seta on either side; posterior pseudopods completely separated, each with a short seta on base and sixteen golden claws, which are semicircularly arranged; shape of claws closely similar to those of *T. halophilæ*.

Habitat.—Immature forms found within the mud tubes built on the matting of the littoral alga, *Boodlea coactata*, on the bottom of the tide pool, spacially associated with *Pontomyia pacifica*. The larvæ mainly feed on the algal débris, and a small quantity of diatoms was usually found in the stomach of the larvæ. From the northern coast of Kyushu, Karatsu Bay, Saga Prefecture, many males of this species, which were swarming over a tide pool, were collected by Mr. Y. Yoshimura (August 7, 1934) to whom I express my hearty thanks for this valuable material, which establishes a new locality for this species.

ILLUSTRATIONS

Plate 1

Fig. 1. *Spaniotoma* (*Smittia*) *littoralis* sp. nov., male wing.
2. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., male wing.
3. *Spaniotoma* (*Smittia*) *endocladiæ* sp. nov., male wing.
4. *Spaniotoma* (*Psectrocladius*) *yukawana* sp. nov., male wing.
5. *Spaniotoma* (*Smittia*) *littoralis* sp. nov., male hypopygium.
6. *Spaniotoma* (*Smittia*) *endocladiæ* sp. nov., male hypopygium.
7. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., male hypopygium.
8. *Spaniotoma* (*Psectrocladius*) *yukawana* sp. nov., male hypopygium.
9. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., spermatheca.
10. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., female cercus.

Plate 2

Fig. 11. *Spaniotoma* (*Psectrocladius*) *yukawana* sp. nov., female cercus.
Figs. 12 to 18. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., immature forms; *12*, ultimate segment of male pupa, dorsal aspect; *13*, ultimate segment of female pupa, dorsal aspect; *14*, larval antenna; *15*, infrabrustia of larval mandible; *16*, larval maxilla, ventral aspect; *17*, larval mentum; *18*, larval premandible.
19 to 25. *Tanytarsus boodleæ* Tokunaga, immature forms; *19*, caudolateral combs of penultimate segment of pupa; *20*, larval maxilla; *21*, larval mentum; *22*, various appendages of labrum and epipharynx, labralia omitted, cephalic aspect; *23*, larval antenna; *24*, larval premandible; *25*, double seta of larval abdomen.

Text figure

Fig. 1. *Spaniotoma* (*Smittia*) *bifurcata* sp. nov., male; *a*, wing; *b*, hypopygium.

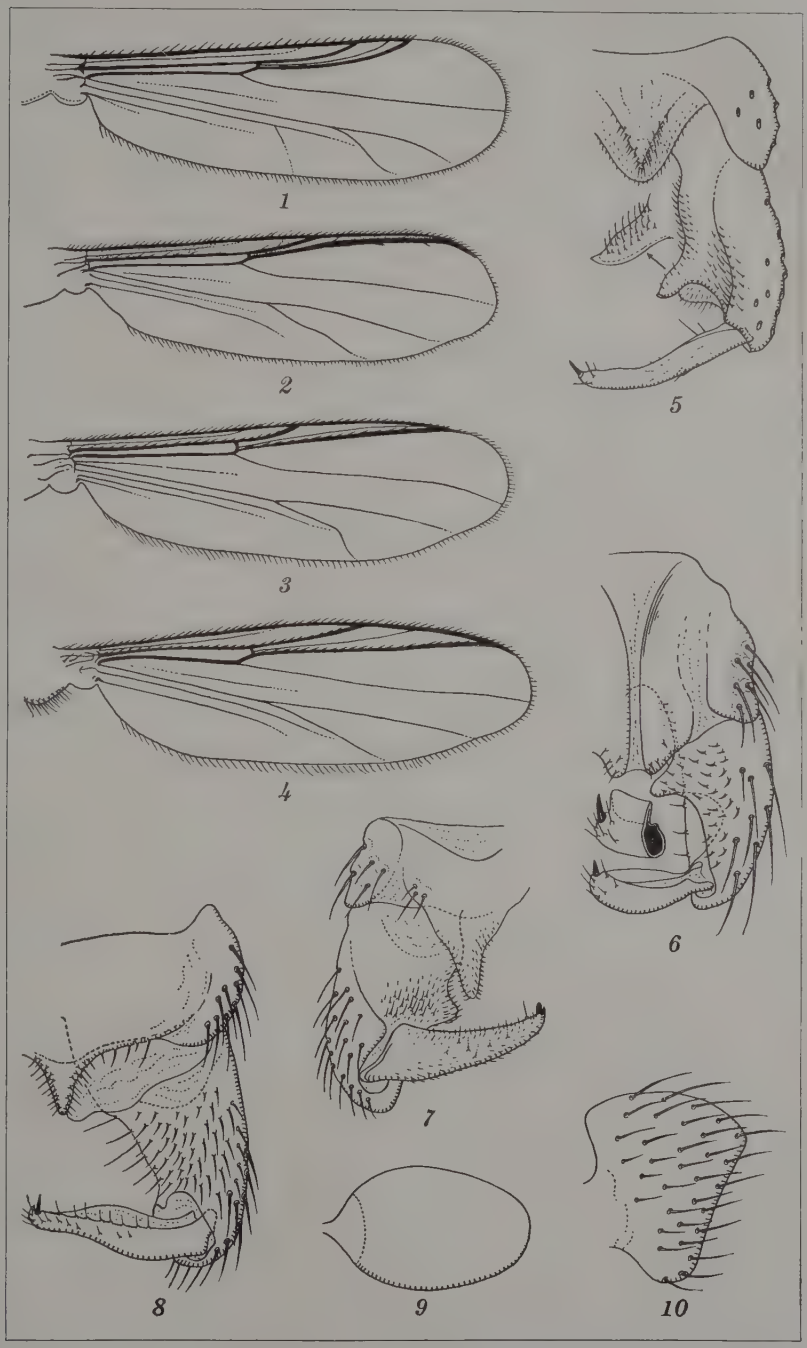

PLATE 1.

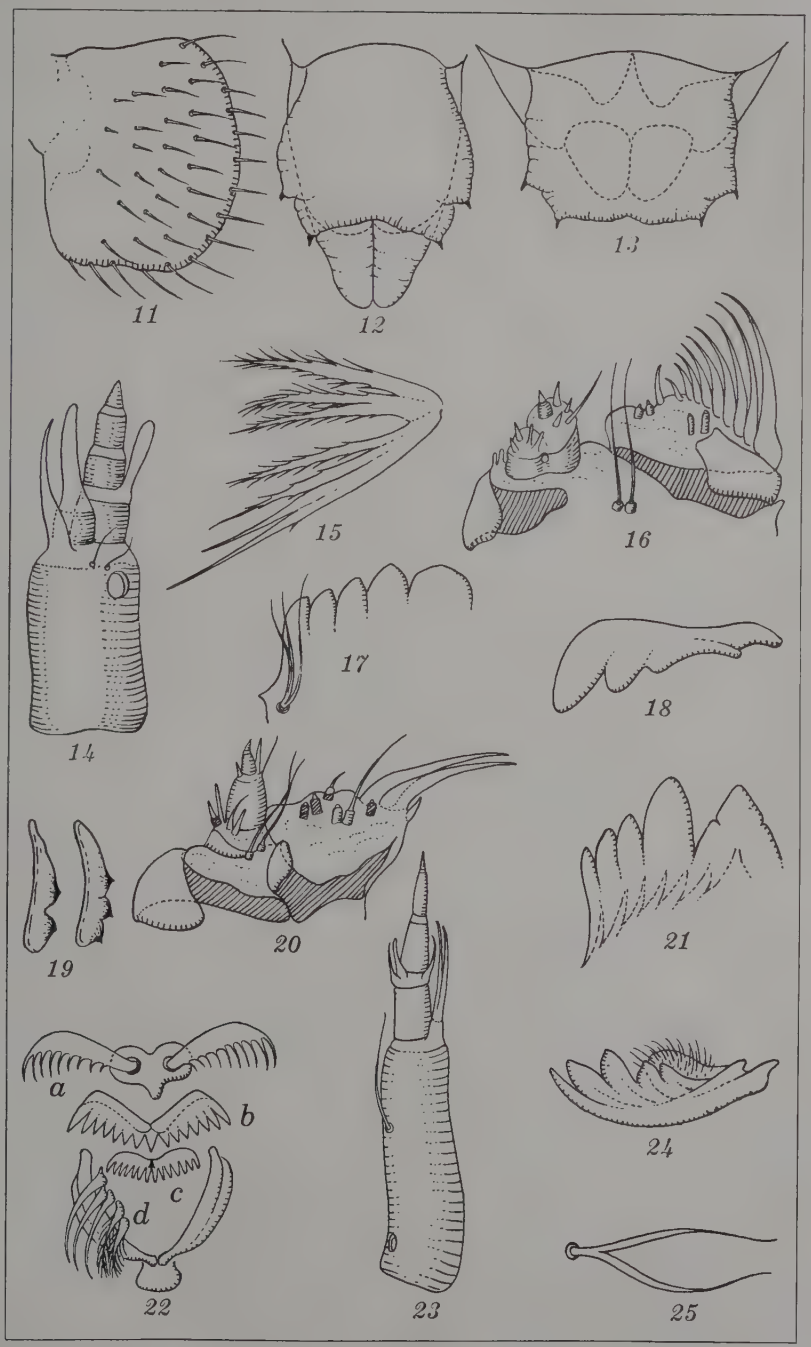

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXI[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

FOUR PLATES

The very interesting crane flies discussed herewith were taken by Rev. Mr. George M. Franck on Mount Omei, Szechwan, western China, chiefly at high altitudes. I am greatly indebted to Mr. Franck for this continued interest in saving the small and medium-sized species of Tipulidæ, flies that are usually overlooked by the general collector. The types of the novelties are preserved in my collection of these flies. The present report adds the following generic and subgeneric groups to the already large list known from China: *Stibadocerella, Discobola, Franckomyia,* and *Ptilostenodes.*

TIPULINÆ

TIPULA (TRICHOTIPULA) LONGIFIMBRIATA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

General coloration of mesonotal præscutum almost uniformly dark brown; wings obscure yellow, many of the veins seamed with brown; numerous macrotrichia in cells beyond cord and in outer ends of some of the more basal cells; cell M_1 sessile or nearly so; male hypopygium with caudal margin of tergite bearing a divaricate blackened fork; inner dististyle produced behind into a short taillike extension.

Male.—Length, about 11 millimeters; wing, 11.5.

Frontal prolongation of head relatively short, brownish black, brighter dorsally at base; nasus distinct; palpi black. Antennæ (male) relatively long, if bent backward extending nearly, if not quite, to base of abdomen; scape and pedicel yellow; flagellum black; basal enlargements of segments scarcely indicated, the segments being nearly cylindrical; longest verticils subequal to segments; terminal segment about one-third the length of the penultimate. Front and anterior vertex obscure yellow; posterior sclerites of head brownish gray.

[1] Contribution from the entomological laboratory, Massachusetts State College.

Pronotal scutum dark brown, the scutellum yellow. Mesonotal præscutum almost uniformly dark brown, without evident stripes in the unique type; scutal lobes blackened, the median area yellowish testaceous; scutellum testaceous, clearer yellow medially; mediotergite brownish yellow. Pleura yellow, variegated with darker on the mesepisternum. Halteres obscure yellow. Legs with the coxæ yellow, the fore coxæ a trifle darkened; trochanters yellow; femora light brown, the tips passing into dark brown; tibiæ dark brown, the tips narrowly blackened; tarsi black; claws (male) with a single erect spine at near midlength. Wings (Plate 1, fig. 1) with the ground color yellow, variegated by brown seams to many of the veins, including the cord, outer end of cell 1st M_2, vein Cu except near outer end, and vein 2d A; outer longitudinal veins more narrowly seamed with brown; extensive paler clouds occupying most of cell 1st A; stigma dark brown; veins brown; macrotrichia black. Abundant macrotrichia in all cells of wing beyond cord, and in outer ends of cells C, R, M, Cu, and 1st A basad of cord (indicated in figure by stippled dots); base of cell 1st M_2 nearly destitute of trichia. Venation: Cell M_1 narrowly sessile or very short-petiolate; m-cu close to fork of M_{3+4}; cell 2d A of moderate width.

Abdominal tergites dark brown, narrowly ringed caudally with testaceous-yellow; sternites more brownish yellow; hypopygium brown. Male hypopygium (Plate 2, fig. 25) with the tergite, 9*t*, almost completely separated from the sternite by extensive pale membrane; basistyle, *b*, elongate, separated from the ninth sternite, 9*s*, by an unusually long, straight, ventral suture. Ninth sternite, 9*s*, viewed from beneath widely filled with pale membrane, the narrow strip delimited beneath the suture with a fringe of unusually long setæ, directed ventrad; a compact oval patch at cephalic portion of row bears more delicate silken setæ. Ninth tergite, 9*t*, with the caudal margin transverse, the median area produced caudad into two, blackened, divergent horns, their tips directed very slightly ventrad. Outer dististyle, *od*, short and broad, the apex truncate, the surface with numerous short setæ. Inner dististyle, *id*, complex, the beak portion blackened, shallowly bifid, beneath this with a second, blackened, fingerlike lobe; apex of style superimposed beneath the blackened beak as a slender pale lobe; caudal portion of style produced backward as a short taillike point. Eighth sternite, 8*s*, relatively small, with caudal border gently convex, the entire surface with sparse, scattered, black setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*).

The general appearance and the wing pattern of the present fly are much as in *Tipula* (*Trichotipula*) *polytricha* Alexander, differing in the glabrous basal cells of the wing, nearly sessile cell M_1, and, especially, the details of structure of the male hypopygium, including the ninth tergite, ninth sternite, and styli.

TIPULA (TRICHOTIPULA) MALLOPHORA sp. nov. Plate 1, fig. 2; Plate 2, fig. 26.

Allied to *longifimbriata;* entire mesonotum dark brown; thoracic pleura dark brown, variegated by paler on the dorsal sternopleurite and pteropleurite; wings with pattern less contrasted, obscure yellow and dark brown; petiole of cell M_1 exceeding m; abdominal tergites and hypopygium brownish black; inner dististyle with a long pale blade, extending backward from the caudal portion.

Male.—Length, 10 to 11 millimeters; wing, 11 to 12.

Female.—Length, about 12 millimeters; wing, 10.5.

Frontal prolongation of head and palpi dark brown. Antennæ with scape and pedicel obscure yellow; flagellum brownish black; flagellar segments with basal enlargements feebly developed; longest verticils shorter than the segments; terminal segment only about one-fourth the length of the subterminal. Head dark brown, very narrowly darker on orbits.

Mesonotum uniformly dark brown, without indications of markings. Pleura dark brown, paler on the dorsal sternopleurite, pteropleurite, and meron. Halteres elongate, the stem dusky except at the narrow yellow base, the apex of knob yellow. Legs with the coxæ brownish testaceous; trochanters brownish yellow; femora brown, the tips passing into darker brown; remainder of legs dark brown, the tarsi passing into black; claws with a strong erect spine before midlength. Wings (Plate 1, fig. 2) with the very restricted ground color obscure yellow, almost obliterated by very extensive brown clouds and seams, appearing chiefly as pale central streaks in the outer radial and medial fields; a spot near outer end of cell M, a seam along vein 1st A, and a spot near outer end of cell 1st A, not far from vein 2d A; cells before cord chiefly of a uniform brown; stigma oval, darker brown; veins dark brown. Abundant macrotrichia in cells of outer two-thirds of wing (shown in figure by stippled dots), lacking in cells near wing base and in all but extreme outer end of cell Sc. Venation: Petiole of cell M_1 longer than m.

Abdominal tergites and hypopygium brownish black, the sternites more reddish brown; basal sternites more darkened medially, the outer segments more uniformly darkened. Male hypopygium (Plate 2, fig. 26) generally as in *longifimbriata* sp. nov., differing especially in the conformation of the ninth tergite and inner dististyle. Arrangement of setæ on ventral margin of ninth sternite very similar in both species, but differing in size and number of the hairs. Ninth tergite, 9*t*, with a median blackened plate that splits at apex into two, feebly divergent, acute spines. Inner dististyle, *id*, very complex in structure, produced behind into a long, pale, compressed blade that is slightly constricted near base; two apical, blackened beaks, both slender, acute, and separated from one another only by a narrow slit; the long, pale, cephalic portion of the style bears on outer or dorsal margin a pale lobe whose edge is ragged or fimbriolate.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Allotype, female, White Cloud Temple, altitude 9,000 feet, July 29, 1935 (*Franck*). Paratype, male, with the allotype.

The nearest ally is undoubtedly *Tipula* (*Trichotipula*) *longifimbriata* sp. nov. The present fly is most readily told by the petiolate cell M_1 and by the details of structure of the male hypopygium, notably the long, pale, caudal blade of the inner dististyle.

TIPULA (SCHUMMELIA) MEMBRANIFERA sp. nov. Plate 1, fig. 3; Plate 2, fig. 27.

Belongs to the *continuata* group; antennal flagellum black; thoracic pleura yellow, the mesepisternum infuscated; femora obscure yellow, the tips rather narrowly blackened; wings infumed, restrictedly variegated by darker brown and yellow areas; cell 1st M_2 small; male hypopygium with the ninth sternite produced ventrad into long, pale, membranous points on either side of midline.

Male.—Length, about 11 millimeters; wing, 12.5; antenna, 4.

Frontal prolongation of head yellow; nasus distinct; palpi brownish black. Antennæ with scape and pedicel brownish yellow; basal flagellar segment brown, the distal third, together with remainder of organ, black; basal enlargements of segments moderately developed; longest verticils unilaterally arranged, a trifle shorter than the segments. Head with front and anterior vertex yellow; posterior vertex brown.

Pronotum brown. Mesonotal præscutum chiefly covered by three brown stripes, the median one further split by a darker brown capillary vitta; posterior interspaces infuscated, the humeral and lateral portions of præscutum broadly yellow; scutal lobes dark brown, the median area paler; scutellum obscure yellow, vaguely darkened medially; postnotum chiefly yellow. Pleura yellow, the dorsopleural region and mesepisternum infuscated. Halteres yellow, the base of knobs infuscated, the apex pale yellow. Legs with the coxæ yellow; trochanters obscure yellow; femora obscure yellow, the tips rather narrowly blackened, a little more broadly so on the fore and middle legs where about the distal sixth is included; tibiæ and tarsi black; claws with long basal spine at near proximal third. Wings (Plate 1, fig. 3) with a strong brownish tinge, restrictedly variegated by darker brown and pale yellow areas; cells C and Sc about of the ground color; stigma oval, dark brown; broad brown seams on m-cu and distal section of Cu_1; yellow areas before and beyond stigma and across base of cell 1st M_2, the last extending into proximal portion of cell M_3; a major yellowish area near outer end of cell M; bases of cells Cu, 1st A, and 2d A a trifle brightened; veins brown, the obliterative areas at fork of M pale. Venation: Rs a little longer than m-cu; cell 1st M_2 small, pentagonal; cell M_1 short-petiolate, the stem a little longer than m; m-cu close to fork of M_{3+4}.

Abdomen with basal four tergites obscure yellow, darker dorsally; outer segments black, the hypopygial appendages pale. Male hypopygium (Plate 2, fig. 27) with the suture between tergite, 9*t*, and sternite, 9*s*, nearly complete; basistyle not evidently separated from sternite. Ninth sternite, 9*s*, on either side produced ventrad into a long, pale, membranous lobe, gradually narrowed to a subacute point, shortly before the free tips united across the midline. Ninth tergite, 9*t*, broadly notched medially, as in the group; lateral lobes broadly rounded, their margins narrowly blackened; base of notch with a very low obtuse lobule. Outer dististyle, *od*, gently arcuated, of moderate length. Inner dististyle, *id*, with the outer margin conspicuously blackened, the outer apical portion extended into a blunt point; two blackened denticles, the more basal one smaller. Eighth sternite, 8*s*, narrow, without lobes or modifications; setæ small and sparse.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

The present fly is readily told from other allied species of *Schummelia* by the wing pattern and venation, and the somewhat remarkable development of pale membrane of the ninth sternite of the male hypopygium. The closest ally is the next-described species, *Tipula* (*Schummelia*) *dissociata* sp. nov.

TIPULA (SCHUMMELIA) DISSOCIATA sp. nov. Plate 1, fig. 4; Plate 2, fig. 28.

Generally similar and closely allied to *T.* (*S.*) *membranifera* sp. nov., differing especially in the details of body and wing coloration, venation, and structure of the male hypopygium.

Male.—Length, about 11 millimeters; wing, 12.

Frontal prolongation of head without clearly defined nasus. First flagellar segment shorter, but succeeding segments longer, than in *membranifera*. Posterior portion of head conspicuously dark brown. Median præscutal stripe not divided by a capillary darker brown vitta. Dark pleural girdle on mesepisternum dark brown, distinct. Apices of knobs of halteres only slightly brightened. Wings (Plate 1, fig. 4) with ground color slightly darker brown; cell Sc dark brown, contrasting conspicuously with the yellow cell C. Venation: Cell 1st M_2 more elongate; m-cu at near midlength of M_{3+4}. Male hypopygium (Plate 2, fig. 28) without a median lobule on caudal margin of ninth tergite. Outer dististyle, *od*, longer and more attenuated. Inner dististyle, *id*, with the blackened lobes of distinct conformation, as shown.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, July 27, 1935 (*Franck*).

TIPULA (SCHUMMELIA) DISSOCIATA TIMENDA subsp. nov.

Female.—Length, about 13 millimeters; wing, 14.

As in the typical form, differing as follows: Nasus evident, slender. Pronotum clear light yellow throughout. Posterior interspaces of præscutum yellow; median region of scutum yellow; scutellum and mediotergite uniformly yellow, without markings. Pleura yellow, not or only insensibly variegated by darker on anepisternum. Apices of knobs of halteres clear yellow. Legs with femoral tips broadly blackened. Wings with cell M_1 narrowly sessile. Abdominal tergites chiefly brownish black, the first segment and sides of the second yellow; succeed-

ing tergites vaguely brightened by obscure yellow areas; subterminal segments uniformly blackened.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

TIPULA (ACUTIPULA) FORTICAUDA sp. nov. Plate 1, fig. 5; Plate 2, fig. 29.

Mesonotum gray, the pleura, including ventral half of pleurotergite, yellow, unmarked; wings with cell C, prearcular region, and stigma light brown, cell Sc uniformly darker brown; a dark cloud at near midlength of cell Cu; abdomen dorsally uniform dark gray, the lateral borders narrowly buffy, margined internally by dark brown; male hypopygium large; ninth tergite simple; inner dististyle with the outer lobe produced into a pendant trunklike portion; caudal margin of eighth sternite weakly bilobed, with conspicuous setæ.

Male.—Length, about 15 to 16 millimeters; wing, 17 to 18.

Frontal prolongation of head dark brown; nasus long and distinct; palpi black. Antennæ with scape and pedicel obscure yellow; first flagellar segment brownish yellow, the remaining segments brownish black; verticils exceeding the segments in length. Head dark brownish gray, the orbits restrictedly paler gray.

Pronotum obscure yellow. Mesonotal præscutum ashy gray with three, scarcely differentiated, brownish gray stripes, the interspaces obscure; extreme cephalic border of præscutum infuscated; posterior sclerites of mesonotum, including the dorsal half of pleurotergite, gray; parascutella yellow. Pleura uniformly light yellow, the dorsopleural membrane a trifle more dusky. Halteres dark brown. Legs with the coxæ and trochanters light yellow; femora obscure yellow, passing into more brownish yellow, the tips narrowly blackened, the amount subequal on all legs; tibiæ brownish black; tarsi passing into black. Wings (Plate 1, fig. 5) with cell C, prearcular region, and stigma light brown; cell Sc much darker brown throughout; general coloration of remainder of wing pale brown, clearer before cord and in basal portions of cells M and Cu; dusky clouds at outer end of cell M and at near midlength of cell Cu; veins dark brown. Venation: Rs a trifle longer than m-cu; petiole of cell M_1 and m subequal.

Abdomen dorsally uniformly dark gray, the lateral borders of the tergites narrowly buffy, margined internally with dark brown; extreme caudal borders of tergites two to four pale;

basal sternites yellow, beyond the second passing into brownish black; hypopygium very large and powerfully constructed, uniformly darkened. Male hypopygium (Plate 2, fig. 29) with the ninth tergite, 9*t*, bearing a moderately broad median lobe that is further narrowed at near two-thirds the length into a simple, blackened, spinulose point. Styli as figured; outer style, *od*, obliquely truncated at apex. Inner dististyle, *id*, with the beak portion heavily blackened, its own crest high; outer lobe of style prolonged into a glabrous trunklike portion, deflected towards the beak of the style, the outer apical angle further produced into a small point; setæ at crest of style powerful, about twenty in number. Eighth sternite, 8*s*, sheathing, the apex concave, each lateral lobe with numerous elongate setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, July 29, 1935 (*Franck*). Paratopotypes, 2 males.

The present fly bears a general resemblance to species such as *Tipula* (*Acutipula*) *quadrinotata* Brunetti, but is readily told from all regional allies by the unusually large hypopygium, with the median lobe of the tergite simple, and the inner dististyle of peculiar conformation.

TIPULA (ACUTIPULA) SUBINTACTA sp. nov. Plate 1, fig. 6; Plate 2, fig. 30.

General coloration of thorax yellow, the præscutum with four entire brown stripes; scutellum yellow, margined with dark brown; legs brown; wings dark, variegated by cream-colored areas before cord and as a continuous line across bases of outer medial cells; male hypopygium with the median lobe of tergite slender; inner dististyle with the outer lobe divided by a rounded notch into two lobes, each bearing groups of spinous setæ.

Male.—Length, about 16 millimeters; wing, 19.

Frontal prolongation of head brown; nasus distinct; palpi brownish black. Antennæ with scape and pedicel light yellow; flagellum brownish black; flagellar segments with basal enlargements relatively small; longest verticils subequal to the segments in length. Head dark brownish gray.

Pronotum dark brown. Mesonotal præscutum obscure yellow, with four entire brown stripes, the intermediate pair relatively narrow and clearly defined, separated by a conspicuous, yellow, median line; lateral stripes less clearly defined, laterally extending towards margin; scutum obscure yellow medially, the lobes extensively darkened; scutellum obscure yellow, conspicuously margined with dark brown; central portion of mediotergite

brown, the lateral and posterior portions yellow pollinose. Pleura yellow, the central portion of pleurotergite darker; dorsopleural membrane feebly darkened. Halteres infuscated, the apex of knob more whitened. Legs with the coxæ and trochanters yellow; remainder of legs uniformly brown, apparently not fully colored in the slightly teneral type. Wings (Plate 1, fig. 6) slightly teneral, but with the pattern entirely indicated; ground color dark, variegated by restricted cream-colored areas before cord, near base of cell 1st M_2, and as an oblique stripe across the basal portions of cells M_1 to M_4, inclusive; a small whitish spot at near two-thirds the length of cell M, adjoining vein Cu; pale areas on either side of the darkened spot lying before midlength of cell Cu; veins dark. Wings relatively narrow, the veins near stigma somewhat crowded. Venation: Rs subequal in length to m-cu; petiole of cell M_1 longer than m; m-cu a short distance before fork of M_{3+4}.

Basal abdominal segments chiefly obscure yellow, the outer ones darker, but not fully colored in the unique type. Male hypopygium (Plate 2, fig. 30) with the median lobe of ninth tergite, 9*t*, unusually slender at apex, set with black spines; on ventral face of lobe with two carinæ that diverge slightly behind. Outer dististyle, *od*, broad, the apex produced into a moderately long lobe; setæ at inner margin near base long and conspicuous. Inner dististyle, *id*, with the beak slender; outer lobe deeply divided by a rounded notch into a broadly obtuse outer lobe, crowned with from twenty-five to thirty spinous setæ, and a narrower, more clavate, basal lobe, its apex produced into a decurved point, the outer surface with abundant spinous setæ. Eighth sternite broad at apex, provided with hair brushes.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

The nearest relative of the present fly seems to be *Tipula* (*Acutipula*) *intacta* Alexander, which has the hypopygium generally similar but differing in all details. The hypopygium is very different in structure from that of *T.* (*A.*) *omeiensis* Alexander and *T.* (*A.*) *yunnanica* Edwards, which have a somewhat similar wing pattern.

TIPULA (VESTIPLEX) AVICULAROIDES sp. nov. Plate 1, fig. 7; Plate 2, fig. 31.

Belongs to the *himalayensis* group; allied to *avicularia;* antennæ (male) elongate, the flagellum black; mesonotal præscutum

with the ground color yellow, with four brown stripes that are insensibly bordered by darker; scutellum and pleura chiefly black, pruinose; wings brownish yellow, very restrictedly variegated by cream-yellow spots; cells beyond cord uniformly of the ground color; basal four abdominal tergites reddish orange, with a narrow darkened dorsal stripe; outer abdominal segments, including hypopygium, black; basistyle with a spine.

Male.—Length, about 14 millimeters; wing, 15; antenna, about 6.5.

Frontal prolongation of head chestnut-brown laterally, darker above; nasus distinct; palpi black, the incisures narrowly pale. Antennæ elongate, as shown by the measurements; scape reddish brown, darkened apically; pedicel pale yellow; flagellum black; flagellar segments elongate, moderately incised, the verticils shorter than the segments; terminal segment tiny. Head light brown, the posterior orbits narrowly yellow, margined internally by a dusky line; posterior vertex with a continuous, black, median vitta.

Pronotum dark brown. Mesonotal præscutum with the ground color, including the interspaces, yellow, the lateral borders behind the pseudosutural foveæ blackish gray; four brown stripes that are insensibly bordered by slightly darker brown, most evident on mesal edges of lateral stripes and as paired submedian lines on intermediate stripes; scutum gray, the lobes conspicuously variegated by dark brown; scutellum black, the surface sparsely pruinose; mediotergite black, heavily pollinose with grayish yellow, with a capillary, median, black vitta. Pleura chiefly blackened, the surface sparsely pruinose; ventral pleurotergite yellow pollinose. Halteres brown, the knobs blackened. Legs with the coxæ dark gray; trochanters obscure yellow; femora obscure yellow basally, passing into brownish yellow, the tips broadly blackened; tibiæ and tarsi black. Wings (Plate 1, fig. 7) with the ground color almost uniformly brownish yellow, cell Sc and the prearcular field clearer yellow; restricted cream-colored spots, distributed as follows: Before stigma in cell R_1; across cell 1st M_2; in basal half and near outer end of cell M; extreme bases of cells Cu and 1st A; two tiny spots near outer end of cell 1st A; outer end of cell 2d A; no sign of brightening in outer radial or medial fields; veins dark, those in outer radial field somewhat paler brown. Venation: Cell 1st M_2 relatively long; m-cu just before fork of M_{3+4}; petiole of cell M_1 subequal to m.

Abdomen with basal four tergites reddish orange, with a narrow, black, continuous, dorsomedian vitta, the lateral borders of the basal two segments less evidently darkened; segments five to nine, inclusive, together with the hypopygial appendages, black, the surface sparsely pruinose. Male hypopygium (Plate 2, fig. 31) small, the basistyle, *b*, entirely separated from the sternite, its posterior angle produced dorsad into a powerful, broad-based, blackened spine, the tip acute. Ninth tergite, 9*t*, small, divided medially by pale membrane, the lateral lobes obtuse. Outer dististyle, *od*, relatively narrow, dusky, with abundant setæ. Inner dististyle, *id*, simple, the beak darkened, the posterior portion of style opposite the beak produced caudad into a yellow triangular flange. Ninth sternite, 9*s*, with a small, blackened, rounded lobe near margin of junction with basistyle, this structure apparently homologous with the bird's-head structure in *avicularia*. Ædeagus pale, jutting caudad from genital chamber, the acute tip strongly decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Nwa Nien Pin Temple, altitude 6,500 feet, July 31, 1935 (*Franck*).

The present fly superficially resembles species such as *Tipula* (*Vestiplex*) *avicularia* Edwards, *T.* (*V.*) *nigroapicalis* Brunetti, and *T.* (*V.*) *pleuracantha* Edwards, differing from all in the wing pattern, with no sign of a poststigmal brightening, and in the structure of the male hypopygium.

TIPULA (OREOMYZA) PROLONGATA sp. nov. Plate 1, fig. 8; Plate 3, fig. 32.

General coloration yellow, the præscutum with three pale brown stripes; antennæ (male) with basal three segments yellow, the remainder black; legs with tips of femora blackened, of the posterior pair narrowly so; wings tinged with dusky, cells C, Sc, and the stigma abruptly brownish black; prearcular region light yellow; outer abdominal segments blackened; male hypopygium with the tergite produced into two slender lobes, separated by a V-shaped notch; a single complex dististyle, produced caudad into a long, flattened, yellow blade.

Male.—Length, about 12 millimeters; wing, 13.

Female.—Length, about 15 millimeters; wing, 14.

Frontal prolongation of head obscure yellow, slightly darker laterally; nasus reduced to a small rounded papilla; palpi dark brown, the terminal segment extensively yellow on distal portion. Antenna (male) relatively long, if bent backward extending to

about midlength of the second abdominal segment; basal three segments light yellow, the remaining segments black; first flagellar segment unusually long, about one-half longer than the second; succeeding segments with basal enlargements feebly developed; verticils shorter than the segments. Front and anterior vertex yellow; posterior portion of head grayish brown, the posterior orbits a little brighter; an exceedingly delicate, capillary, median, dark line.

Pronotum yellow. Mesonotal præscutum with the dorsum almost uniformly pale yellowish brown, the three stripes scarcely darker and poorly delimited against the ground; lateral margins of præscutum yellow; scutal lobes feebly darkened; scutellum and mediotergite yellow. Pleura uniformly yellow. Halteres obscure yellow, the knobs darkened. Legs with the coxæ and trochanters yellow; femora yellow basally, soon passing into obscure yellow, the tips blackened, more broadly so on the fore and middle legs, narrowly so on the posterior femora; tibiæ and tarsi black; claws (male) with long basal spine. Wings (Plate 1, fig. 8) with a dusky tinge; cells C and Sc, together with the stigma and a confluent seam on anterior cord, brownish black; prearcular cells light yellow; posterior cord and longitudinal veins beyond cord very narrowly seamed with brown; veins brownish black to black, brightened in prearcular field. Venation: R_{1+2} entire; Rs long, nearly twice m-cu; petiole of cell M_1 shorter than m; M_{3+4} shorter than the basal section of M_{1+2}; cell 2d A narrow.

Abdomen with basal three tergites yellow, unmarked; succeeding two tergites darkened laterally; sixth and remaining segments black, sparsely pruinose; lateral borders of tergites five to eight, inclusive, broadly light gray; basal sternites yellow. Male hypopygium (Plate 3, fig. 32) with the tergite, 9*t*, entirely separated from the sternite, 9*s;* basistyle incompletely separated from sternite by a ventral suture, its outer end not at all produced; dististyle inserted unusually far ventrad. Ninth tergite, 9*t*, a large, quadrate, blackened plate, its caudal margin further extended into a broad, depressed, blackened ledge that is deeply split by a V-shaped notch, the lateral lobes slender, with microscopic black spines on mesal face at apex. A single complex dististyle, *d*, the usual outer style reduced to a tiny lobe; main body of style produced caudad beyond the other elements of the hypopygium as a flattened yellow blade, the sides parallel,

the apex obtuse. Eighth sternite relatively small, without armature of modified lobes or setæ.

Female with the genital shield and bases of hypovalvæ intensely black; cerci horn-color, straight and slender, the tips gently decurved; hypovalvæ beyond base reddish horn-color, compressed.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, July 29, 1935 (*Franck*). Allotopotype, headless female, summit, altitude 11,000 feet, August 18, 1934 (*Graham*); United States National Museum.

In its general appearance, the present fly is much like *Tipula* (*Vestiplex*) *testata* Alexander, but belongs to a different subgeneric group, and is entirely distinct in the details of wing pattern and structure of the male hypopygium.

CYLINDROTOMINÆ

STIBADOCERELLA OMEIENSIS sp. nov. Plate 1, fig. 9.

General coloration greenish testaceous, the præscutum and scutum variegated with dark brown; antenna (male) about one-half longer than body, the flagellum whitish; fore tibiæ with base and apex broadly white; remaining tibiæ without a pale basal ring; basitarsi entirely dark brown; wings with second and third sections of vein M_{1+2} subequal; cell 2d A ending about opposite the proximal end of the arculus.

Male.—Length, about 9.5 millimeters; wing, 9.3; antenna, about 14.5.

Rostrum pale yellow; palpi black. Antennæ about one-half longer than the body; scape and pedicel pale green; flagellum whitish, the outer segments passing into pale green. Head greenish testaceous, smooth.

Pronotum pale greenish yellow. Mesonotal præscutum pale greenish with three dark brown stripes; scutal lobes similarly darkened; remainder of mesonotum pale testaceous. Pleura uniformly pale, the ventral sclerites, with the coxæ, with a strong greenish tinge, undoubtedly strongly marked and conspicuous in living individuals. Halteres elongate, the stem pale brown, the knob blackened. Legs with the coxæ and trochanters greenish testaceous; femora pale greenish brown, the tips somewhat darker; fore tibiæ with base broadly white, the tip similarly colored and nearly twice as extensive as the base; remaining

tibiæ pale greenish brown, with no indication of white rings, either at base or apex; all basitarsi brown; outer four tarsal segments of all legs white, with a distinct greenish tinge, the pretarsus darkened; basal third to fourth of second tarsal segment of fore and middle legs slightly darkened; posterior legs broken beyond midlength of tibiæ. Wings (Plate 1, fig. 9) crystal clear, with black veins. Venation: Sc_1 ending shortly before r-m, Sc_2 at its tip; basal section of Rs a trifle longer than the distal portion; basal section of M_3 long, arcuated, exceeding twice the length of m; third section of M_{1+2} subequal to second section of the same vein; cell 2d A ending about opposite the proximal end of arculus.

Abdomen pale yellowish brown, the pleural areas somewhat darker.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 5,500 feet, July 27, 1935 (*Franck*).

The present species is well distinguished from the three previously described in *Stibadocerella* by the whitish antennal flagellum, lack of a basal pale annulus on middle and posterior tibiæ, and the marked restriction of white color on the tarsi.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) OMNIFLAVA sp. nov. Plate 1, fig. 10; Plate 3, fig. 33.

General coloration pale yellow, the præscutum with a weakly indicated, brown, median stripe, restricted to anterior half; head black; antennæ 15-segmented, the flagellum chiefly yellow; legs yellow, only the terminal tarsal segments blackened; wings uniformly pale yellow; Sc_1 ending about opposite two-thirds the length of Rs, Sc_2 a little longer than Sc_1; R_{1+2} elongate; abdominal tergites darkened medially; hypopygium with the dististyle extended into a boomerang-shaped apical point; ædeagus terminating in two divergent points.

Male.—Length, about 9 millimeters; wing, 10.

Rostrum and palpi black. Antennæ 15-segmented, there being thirteen flagellar segments; scape black; pedicel dark brown; flagellum yellow, the outer three or four segments brownish yellow; basal flagellar segments oval, the outer ones elongate; terminal segment only a trifle shorter than the penultimate; verticils of outer segments shorter than the segments themselves. Head black; anterior vertex reduced to a narrow strip.

Cervical region brownish black. Pronotum and mesonotum pale yellow, the præscutum with a weakly indicated, more brownish, median stripe on its anterior half. Pleura pale yellow. Halteres relatively elongate, pale yellow, the knobs weakly darkened. Legs pale yellow, only the outer four tarsal segments blackened; tarsi relatively long and slender; claws with a single slender subbasal tooth. Wings (Plate 1, fig. 10) uniformly pale yellow; stigma not indicated; veins brownish yellow. Venation: Sc long, Sc_1 ending at near two-thirds the length of Rs, Sc_2 at tip of Sc_1; R_{1+2} long, nearly three times R_2 alone; cell 1st M_2 of moderate length; m-cu close to fork of M.

Abdominal tergites medially uniform dark brown, the sides pale yellow; sternites pale yellow; hypopygium obscure yellow, the dististyles chiefly darkened. Male hypopygium (Plate 3, fig. 33) with the tergite, 9*t*, gently concave on central portion of caudal border. Basistyle with ventromesal lobe very obtuse, occupying most of mesal face of style. Dististyle, *d*, with base slightly dilated, dusky, the long apical yellow point more or less boomerang-shaped, slightly compressed, with a longitudinal lateral carina. Gonapophyses, *g*, heavily blackened at, and back from, the acute tips. Ædeagus, *a*, broad, terminating in two divergent points, the surface of outer half microscopically scabrous.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

By keys to the species of *Limonia* in the western Palæarctic fauna the present fly runs to *Limonia* (*Limonia*) *stigma* (Meigen), which has a very different hypopygium. There is no very close ally in the eastern Palæarctic Region.

LIMONIA (LIMONIA) TESSELLATIPENNIS sp. nov. Plate 1, fig. 11; Plate 3, fig. 34.

General coloration yellow, the præscutum with three incomplete brownish black stripes, the short lateral pair bent laterad at anterior ends, reaching the margin; knobs of halteres dark brown; legs elongate; femora obscure yellow, with a narrow black ring before tip and a more diffuse darkened annulus at near two-thirds the length of the segment; wings yellow, with a heavy, tessellated, brown pattern; stigma pale brown, ringed with dark brown; Sc long; Rs angulated on basal third; R_{1+2} unusually long, exceeding R_{2+3}; inner end of cell 1st M_2 arcuated; m-cu before fork of M; abdomen chiefly yellow, the subterminal segments blackened; male hypopygium with a single dististyle that

is pale, narrowed to the subacute tip; cerci simple, elongate, and very slender.

Male.—Length, about 12 millimeters; wing, 12.

Female.—Length, about 13 to 14 millimeters; wing, 12 to 13.5.

Rostrum and palpi black. Antennæ with scape brownish yellow; pedicel yellow; basal flagellar segments obscure yellow, the outer ones passing into brown; flagellar segments cylindrical, with long conspicuous verticils that much exceed the segments in length, the longest of these being unilaterally arranged, one to each segment; terminal segment elongate, about one-half longer than the penultimate. Head brown, somewhat paler on occiput; anterior vertex and front black, sparsely pruinose, the former (male) reduced to a linear strip.

Pronotum yellow, narrowly dark brown medially. Mesonotal præscutum yellow, with three brownish black stripes, the median one not attaining the cephalic border of the sclerite nor the suture behind; lateral stripes with their anterior ends bent laterad to margin, the posterior ends not reaching suture; scutum with lobes extensively blackened, this color produced laterad along the suture, median area pale; scutellum pale medially at base, the posterior border margined with brown; mediotergite dark brown, the lateral margins pale. Pleura yellow, weakly darkened on ventral sternopleurite and ventral pleurotergite, and, in certain cases, along the cephalic border of the pteropleurite; a more intensely colored but small spot beneath wing root; dorsopleural membrane faintly dusky. Halteres relatively long, yellow, the knobs dark brown. Legs long and slender; coxæ yellow, the outer faces of fore and middle coxæ weakly darkened; trochanters yellow; femora yellow, more obscure brownish yellow on basal two-thirds, the distal third clearer yellow, with a narrow black subterminal ring about its own length before tip; a second, usually wider but more diffuse, femoral annulus immediately preceding the yellow subterminal ring; tibiæ brownish yellow, the tip narrowly darker; tarsi black; claws (male) with three basal teeth, the outer one larger. Wings (Plate 1, fig. 11) yellow, with a tessellated dark brown pattern that appears as linear streaks in centers of anterior cells and a heavier, more extensive, chiefly marginal pattern in the cells of posterior half of wing; cells C and Sc uniformly light yellow, scarcely variegated by darker; prearcular field brownish yellow; stigma elongate, pale brown, ringed with dark brown; cord, outer end of cell 1st M_2, and tip of vein Sc narrowly seamed with

darker brown; veins brown, yellow in the flavous costal portions. Venation: Sc long, Sc_1 ending shortly before fork of Rs, Sc_2 longer, oblique in position, its distal end about opposite this fork; Rs angularly bent on basal third; R_{1+2} of unusual length, exceeding vein R_{2+3} and subequal to or longer than vein Sc_2+R_1; basal section of R_{4+5} strongly arcuated to angulated and spurred at near midlength; inner end of cell 1st M_2 strongly arcuated, lying about on a level with cell R_3; m-cu before fork of M; cell 2d A relatively narrow.

Abdomen with basal segments yellow, the pleural region and caudal borders very narrowly darkened; subterminal segments black; hypopygium yellow; in the female the basal abdominal segments more brownish yellow. Male hypopygium (Plate 3, fig. 34) with apical margin of tergite, 9*t*, notched. Dististyle, *d*, pale, curved to the subacute tip. Gonapophyses, *g*, with short apical point. Ædeagus, *a*, narrowed to the bilobed apex. Ovipositor with cerci long and very slender, the tips acute.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*). Allotopotype, female. Paratopotype, female.

The present fly is most generally similar to *Limonia* (*Limonia*) *cranbrooki* Edwards, differing in the body coloration, uniformly darkened knobs of halteres, leg and wing pattern, and details of venation, as the usually long R_{1+2} and the smaller cell 1st M_2.

LIMONIA (DISCOBOLA) TAIVANELLA Alexander.

Limonia (*Discobola*) *taivanella* ALEXANDER, Philip. Journ. Sci. 43 (1930) 511–512.

Described from the high mountains of Formosa. A small series, including both sexes, was taken at light at White Cloud Temple, Mount Omei, Szechwan, western China, altitude 9,000 feet, July 29, 1935, by Franck.

LIMONIA (DICRANOMYIA) STERNOLOBATA sp. nov. Plate 1, fig. 12; Plate 3, fig. 35.

Size large (wing, male, over 9 millimeters); general coloration gray; rostrum, palpi, and antennæ black throughout; femora black, the bases narrowly yellow; wings handsomely tinted with pale yellow, the prearcular cells bright yellow; a sparse darker wing pattern, including a weak suffusion in outer radial field; basal abdominal segments yellow, the outer ones black; male hypopygium with each basistyle produced ventrad and caudad into a long fingerlike lobe.

Male.—Length, about 10 millimeters; wing, 9.2.

Female.—Length, about 10 millimeters; wing, 10.

Rostrum and palpi black. Antennæ black throughout; flagellar segments short-oval, beyond the fourth or fifth flagellar becoming more elongate; basal four or five flagellar segments with very short apical pedicels, the succeeding segments sessile; verticils longer than the segments, except on the outer ones; terminal segment about one-third longer than the penultimate. Head dark gray, clearer gray on front and anterior vertex, more grayish brown behind; anterior vertex (male) relatively wide, about equal to twice the diameter of scape.

Pronotum black. Mesonotum dark gray, the præscutum with a single, conspicuous, subnitidous black, median stripe that does not reach the suture behind. Pleura heavily gray pruinose, the dorsopleural membrane brown. Halteres short, the base of stem yellow, the remainder dusky, the knobs blackened. Legs with the coxæ obscure brownish yellow; trochanters yellow; femora black, only the narrow bases yellow; tibiæ a little paler, brownish black, the bases narrowly, the tips more broadly, blackened; tarsi black; claws only slightly curved, with two basal teeth, the outermost larger. Wings (Plate 1, fig. 12) handsomely tinted with very pale yellow, the prearcular cells clear bright yellow; cell Sc dark brown; stigma short-oval, dark brown, confluent with a very narrow dark seam on cord; vein Cu and outer end of cell 1st M_2 seamed with darker; cells R_2 to M_2, inclusive, weakly suffused with brown; axilla feebly darkened; veins black, the prearcular field and vein Sc_2+R_1 before stigma light yellow. Venation: Sc short, Sc_1 ending opposite or immediately before origin of Rs, Sc_2 some distance back from tip; free tip of Sc_2 short, a little proximad of the long R_2, vein R_1 thus reduced to a short element; m-cu at or just before fork of M; vein 2d A long.

Basal six abdominal segments yellow, the succeeding segments, including most of the hypopygium, black; ventral dististyle yellow. Male hypopygium (Plate 3, fig. 35) very large and complicated, chiefly by outgrowths of the basistyle. Basistyle, *b*, produced ventrad and caudad into long, dark, fingerlike lobes; near proximal end a small lobe, fringed at apex with wavy setæ; at near midlength beyond this point the lobe is slightly bent, at point of angulation with a dense tuft of very long delicate setæ. Dorsal dististyle small and slender, entirely superimposed over the ventral style; near base bent at a right angle. Ventral

dististyle, *vd*, relatively small, the rostral prolongation very broad, its outer apical angle produced into a spinous point; rostral spines two, placed close together at base of this point; ventral margin of lower lobe of prolongation with a dense fringe of yellow setæ; from extreme base of style a tuft of very long slender setæ; mesal face of fleshy lobe of style, at base of prolongation, with a dense group of setæ. Gonapophyses, *g*, with the mesal-apical angle produced into a slender, gently curved, black spine. Ædeagus, *a*, sinuous, slender, dusky in color.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Allotopotype, female.

This striking species adds still another member to the subgenus *Dicranomyia* having an enlarged and complicated male hypopygium. From other regional allies in eastern Asia, as *Limonia* (*Dicranomyia*) *bifusifera* (Edwards), *L.* (*D.*) *grahamiana* Alexander, *L.* (*D.*) *megacauda* (Alexander), *L.* (*D.*) *platyrostra* (Alexander), and *L.* (*D.*) *veternosa* Alexander, the present fly is amply distinguished by the large size and by the structure of the male hypopygium. The male sex of *L.* (*D.*) *transfuga* Alexander, of Kashmir, is still unknown, but the fly is entirely different in coloration from the present insect.

HEXATOMINI

ADELPHOMYIA (ADELPHOMYIA) CERINA sp. nov. Plate 1, fig. 13; Plate 3, fig. 36.

General coloration of thorax pale wax yellow; antennæ 16-segmented, black beyond the scape; wings narrow, hyaline, the stigma insensibly darker; macrotrichia of wing cells reduced to a minimum in outer end of cell R_4; Rs elongate; abdomen pale brown, darker subterminally; male hypopygium with dististyles subterminal, the apex of basistyle produced into an acute spine.

Male.—Length, about 3.5 millimeters; wing, 4 by 1.2.

Rostrum pale yellow; palpi darker. Antennæ 16-segmented; basal segment pale, the pedicel and flagellum black; pedicel enlarged; basal flagellar segments more or less bulging on lower face, beyond the fourth passing through oval to elongate; verticils exceeding the segments in length. Head pale brownish yellow.

Mesonotum and pleura entirely wax yellow, the surface more or less nitidous. Halteres relatively elongate, pale. Legs with the coxæ and trochanters yellow; remainder of legs broken.

Wings (Plate 1, fig. 13) narrow, as shown by the measurements; hyaline, the stigma insensibly darker; veins brownish yellow, a little darker colored than the ground; macrotrichia black. Macrotrichia of cells reduced to a minimum of about three in distal end of cell R_4 (indicated in figure by stippled dots). Venation: Sc_1 ending shortly before fork of the long, gently arcuated Rs; R_{2+3+4} about twice R_2, the latter subequal to R_{2+3}; cell M_1 present; m-cu at near midlength of cell 1st M_2; vein 2d A long, ending nearly opposite the origin of Rs.

Abdomen pale brown, darker subterminally; hypopygium obscure yellow. Male hypopygium (Plate 3, fig. 36) with the dististyles subterminal in position, the basistyle, *b*, produced caudad beyond the point of their insertion into an acute pale spine; setæ of basistyle very large and coarse on outer half or less. Outer dististyle, *od*, slender, terminating in two acute spines, the apical one a little longer and more curved; before apex on lower edge with four or five microscopic denticles. Inner dististyle, *id*, dilated at base, the surface with abundant setulæ and a few coarse setæ, the narrowly obtuse apex more glabrous. Basal gonapophyses, *g*, appearing as very slender, straight spines.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

The present species is readily told from allied regional forms by the narrow hyaline wings, with the macrotrichia of the cells unusually reduced in number. The nearest described ally is *Adelphomyia* (*Adelphomyia*) *nipponensis* Alexander, which differs in the coloration of the body and wings, abundant macrotrichia of the outer cells of wing, and details of structure of the male hypopygium.

PHYLLOLABIS LAUDATA sp. nov. Plate 1, fig. 14; Plate 3, fig. 37.

General coloration of mesonotum testaceous-brown, the mediotergite and pleura dark brown; head brown, the anterior portions and orbits gray; legs obscure yellow; wings strongly suffused with brown, the stigma a little darker; R_{2+3+4} of moderate length, only a little more than one-third the length of Rs; M_{3+4} subequal to basal section of M_3; m-cu close to fork of M_{3+4}; male hypopygium with apical fleshy lobe of basistyle short.

Male.—Length, about 7.5 millimeters; wing, 8.5.

Rostrum brown; palpi black. Antennæ with scape and pedicel black, the flagellum paler, dark brown; flagellar segments cylindrical, the verticils shorter than the segments; terminal

segment a little shorter than the penultimate. Head with the front, anterior vertex, and posterior orbits gray, the posterior portion of head more infuscated; anterior vertex a little wider than the diameter of scape.

Pronotum dark brown. Mesonotal præscutum, scutum, and scutellum almost uniformly testaceous-brown, without distinct markings; mediotergite darker. Pleura uniformly dark brown, including the dorsopleural membrane. Halteres with the stem obscure yellow, the knobs infuscated. Legs with the coxæ brownish yellow, the fore pair a little darker; trochanters obscure yellow; remainder of legs obscure yellow, the outer tarsal segments a little darkened. Wings (Plate 1, fig. 14) strongly suffused with brown, almost uniformly distributed and without a distinct pattern other than the slightly darker, diffuse stigma; cell R, adjoining the outer end of vein M and the basal portions of cells 1st A and Cu slightly paler; veins brownish black, distinct against the ground. Macrotrichia of veins abundant, long and conspicuous. Venation: R_{2+3+4} of moderate length and arcuation, shorter than cell 1st M_2 and only a little more than one-third the length of Rs; M_{3+4} subequal to the basal section of M_3; m-cu close to the fork of M_{3+4}.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 3, fig. 37) massive and barrel-shaped, as in the genus; appendage of ninth sternite reduced to a narrow pale strip. Styli as shown, the darkened apical fleshy lobe of basistyle, *b*, less than one-half the length of the body of the style and shorter than the fleshy mesal lobe of latter. Outer blades of basistyle, *b*, simple at tips. Dististyle, *d*, with microscopic punctures at apex.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*).

Phyllolabis laudata is very distinct from the other Himalayan and western Chinese species of the genus, as *P. beesoni* Alexander, *P. confluenta* Alexander, *P. pictivena* Alexander, and *P. regelationis* Edwards. The uniformly colored wings, with unusually elongate Rs, and the structure of the male hypopygium readily separate the species from the above allied forms. I would consider *P. pictivena* to be its closest described relative, the species being readily told by the black coloration of the body, the conspicuously patterned wings, and the structure of the male hypopygium.

PHYLLOLABIS PICTIVENA Alexander. Plate 3, fig. 38.

Phyllolabis pictivena ALEXANDER, Philip. Journ. Sci. 49 (1932) 394.

The unique type, a female, was from the summit of Mount Omei, taken July 18, 1931, by Mr. Franck. The same collector secured a number, including both sexes, at the same place and altitude, July 30, 1935.

Allotype, male.—Length, about 8 millimeters; wing, 9.

Characters essentially as in the female, including the color of the legs, wings, and thorax. Male hypopygium (Plate 3, fig. 38) generally as in *laudata* sp. nov., and certain allied forms in the Nearctic fauna. Apical fleshy lobe, *b*, of basistyle very long, exceeding in length the body of style, about twice as long as the fleshy mesal lobe of the latter, and nearly equal in length to the bladelike extensions of the basistyle, *b*. The latter are apparently two in number, or at least deeply divided at apex so as to appear as two blades, in slide mounts superimposed; outer blade terminating in two, slender, chitinized points. Dististyle, *d*, not exceeding in length the shortest blade of the basistyle. Appendage of ninth sternite reduced to a linear pale strip.

PHYLLOLABIS VULPECULA sp. nov. Plate 1, fig. 15.

General coloration of mesonotum brown; legs black; wings with a strong fulvous-yellow tinge, the costal region and outer radial field deeply saturated with the same color; veins pale, poorly delimited against the ground; Rs a little longer than R_{2+3+4}; cell 1st M_2 elongate; m-cu just before fork of M_{3+4}; abdomen obscure brownish yellow, darker subterminally.

Female.—Length, about 7 millimeters; wing, 7.

Rostrum and palpi black. Antennæ pale brown throughout; flagellar segments oval, the terminal segments smaller. Head brownish gray.

Pronotum infuscated. Mesonotal præscutum and scutal lobes infuscated, the scutellum and mediotergite a trifle brighter. Pleura obscure yellow. Halteres weakly infuscated, the base of stem restrictedly pale. Legs with the coxæ and trochanters yellow; remainder of legs brownish black to black. Wings (Plate 1, fig. 15) with a strong fulvous-yellow tinge, the costal region and, especially, the outer radial field deeply saturated with the same color; stigma not different in color from the radial field; pale streaks in cell R adjoining the outer portion of vein M and in cell 1st A along the basal portion of the vein; veins pale, poorly defined against the ground. Venation: Sc_1

ending beyond midlength of R_{2+3+4}, Sc_2 pale, a short distance from the tip of Sc_1; Rs a little longer than R_{2+3+4}; cell 1st M_2 elongate, the second section of vein M_{1+2} exceeding two-thirds of the distal section; basal section of vein M_3 elongate, a little shorter than M_{3+4}; m-cu just before fork of M_{3+4}.

Abdomen obscure brownish yellow, darkened subterminally. Ovipositor with the cerci relatively strong, reddish horn-color, the margins smooth.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

Phyllolabis vulpecula is very different from the other species of the genus so far discovered in eastern Asia. The saturated fulvous wings, with unusually elongate cell 1st M_2, will suffice to separate the fly from all these allied forms (indicated under the account of *P. laudata* sp. nov.).

ERIOPTERINI

Genus FRANCKOMYIA novum

Antennæ (Plate 4, fig. 39, *at*) 12-segmented; pedicel not markedly enlarged; flagellum with a very long, basal, fusion segment, involving five segments, the fused element being equal in length to the succeeding five free segments; flagellar segments beyond the fusion cylindrical, the verticils subequal in length to the segments. Tibiæ spurless; claws simple. Wings (Plate 1, fig. 16) with Sc long, Sc_1 ending shortly before the fork of R_{2+3+4}, Sc_2 not far from its tip; R_3 suberect at base, weakly angulated at the narrowest point of cell R_1; no distinct R_2, its former position evidently indicated by the approximation of veins R_1 and R_{2+3}; a supernumerary crossvein in cell R_3 at near two-thirds the length, the cell somewhat constricted at point of insertion of the crossvein; cell M_1 present, subequal to its petiole; m-cu shortly beyond fork of M; vein 2d A of moderate length, ending shortly before level of origin of Rs. Male hypopygium (Plate 4, fig. 39) with the basistyle, *b*, of unusual length and slenderness, the distal end produced caudad beyond the point of insertion of the dististyle as a subquadrate pale flap that is provided with abundant setæ; near base of style on mesal face with a slender fingerlike lobe. Dististyle, *d*, bearing a gently curved blackened spine on outer margin before midlength; remainder of style narrowed to the pendant apex. Gonapophyses, *g*, blackened, narrowed at apex into a strong straight spine, the outer surface microscopically scabrous. Ædeagus, *a*, small.

Genotype.—Franckomyia discalis sp. nov. (Palæarctic Region: Western China).

I take great pleasure in naming this very interesting new group of crane flies in honor of Rev. Mr. George Meredith Franck, to whose serious efforts in collecting these flies we owe much of our present knowledge of the Tipulidæ of western China. This curious fly belongs to the subtribe Cladurariа and is evidently most closely related to *Pterochionea* Alexander and *Crypteria* Bergroth. The greatest points of similarity to *Pterochionea* are found in the very elongate fusion segment of the flagellum and the single dististyle of the male hypopygium; to *Crypteria,* a relationship is indicated by the upward swing of vein R_{2+3} near its base, narrowing cell R_1 at this point. Compared with *Pterochionea,* the condition of the fusion segment in the present fly is evidently more specialized, as there are no traces of incomplete sutures, indicating the former limits of the components of the fusion; the details of the hypopygium are very distinct in the two groups. Compared with *Crypteria,* the condition of the fusion segment is undoubtedly more generalized, being fully as elongate as the succeeding five segments of the flagellum; the hypopygium of *Crypteria* is very different, with two dististyles. The complete loss of vein R_2 in the present insect is presaged in certain specimens of *Crypteria* and allied groups, where the element tends to become evanescent. From both of the above-mentioned genera, as well as all other generic groups in the Cladurariа, the present fly differs conspicuously in the strong supernumerary crossvein in cell R_3 of the wings.

FRANCKOMYIA DISCALIS sp. nov. Plate 1, fig. 16; Plate 4, fig. 39.

Mesothorax reddish yellow, unmarked; head dark gray; legs yellow, the femoral tips, tibial bases and tips, and outer tarsal segments darkened; wings nearly hyaline, with certain of the discal veins, including the cord and outer end of cell 1st M_2, darkened.

Male.—Length, about 4.8 to 5 millimeters; wing, 5.5 to 6.

Rostrum and palpi black. Antennæ black throughout, the structure (Plate 4, fig. 39, *at*) as described under the generic diagnosis. Head dark gray.

Pronotum infuscated. Mesothorax uniformly reddish yellow, without markings. Halteres uniformly pale. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly and gradually infuscated; tibiæ white, the bases and tips very narrowly and insensibly darkened, the amounts subequal; tarsi

with outer segments darkened; legs moderately hairy. Wings (Plate 1, fig. 16) nearly hyaline, with a restricted brown discal pattern, appearing chiefly as a darkening of the veins, as follows: Cord; outer end of cell 1st M_2; supernumerary crossvein in cell R_3; fork of M_{1+2}; outer section of vein M_3; veins pale, except as indicated above. Venation as discussed under the genus.

Abdominal tergites brownish black, the basal sternites paler, the outer sternites dark, sparsely pruinose; styli brown. Male hypopygium (Plate 4, fig. 39) as discussed under the genus.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Paratopotype, male.

Franckomyia discalis is very different in its general appearance from all other described members of the subtribe Cladurariа in eastern Asia. Superficially, the fly resembles more closely a species of the genus *Dicranota* (*Amalopina*), as *dicranotoides* (Alexander), than it does any other crane fly.

TRENTEPOHLIA (MONGOMA) ENERVATA sp. nov. Plate 1, fig. 17.

General coloration of body dark brown, the median area of scutum and the scutellum testaceous-yellow; legs dark brown, the tips of all tibiæ narrowly whitened; all tarsi white; wings with a strong dusky tinge; Rs shorter than the gently sinuous R_{2+3+4}; cell 1st M_2 relatively short and broad; m-cu just before fork of M; abdomen dark brown.

Female.—Length, about 7 millimeters; wing, 6.2.

Rostrum black, palpi paling to yellow. Antennæ black throughout; flagellar segments cylindrical, the longest verticils subequal to or a trifle shorter than the segments; terminal segment elongate. Head brownish black.

Pronotum brownish black. Mesonotum dark brown, the median area of scutum and the scutellum paling to testaceous-yellow. Pleura dark brown, the posterior sclerites, surrounding the root of halteres, a trifle paler. Halteres dusky, the extreme base of stem pale. Legs with the coxæ darkened, especially the fore pair which are almost black; trochanters obscure yellow; femora dark brown; tibiæ brown, a trifle paler outwardly, the tips narrowly but conspicuously white, including the setæ; amount of white on tibiæ subequal on all legs, involving approximately the distal tenth of the segment; tarsi white, the terminal segment scarcely darker; fore and middle femora with from six to eight small blackened spines at base; posterior tibiæ with

a long black terminal seta. Wings (Plate 1, fig. 17) with a strong dusky tinge, the prearcular and costal areas somewhat clearer; stigmal region small, infuscated; veins dark brown. The outer medial branches and distal half of R_4 pale and semievanescent; axillary margin of wing with three, long, powerful setæ. Venation: Sc_1 ending opposite the proximal end of vein R_2; Rs shorter than the gently sinuous R_{2+3+4}; veins R_3 and R_4 diverging; cell 1st M_2 relatively small, its greatest width exceeding one-half the length; inner end of cell 2d M_2 lying shortly more distad than the subequal cells R_5 and M_3; m-cu shortly before fork of M; distal fusion of Cu_1 and 1st A slight.

Abdomen dark brown, the cerci and hypovalvæ horn yellow.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Shin Kai Si Temple, altitude about 4,000 feet, at light, August 4, 1935 (*Franck*).

Trentepohlia (*Mongoma*) *enervata* is very different from the other regional species of the subgenus in the conspicuously whitened tips of all the tibiæ, in conjunction with the uniformly darkened femora and the white tarsi. The nearest regional ally is *T.* (*M.*) *montina* Alexander (Formosa), which differs especially in the coloration of the legs and in the details of venation. Another species *T.* (*M.*) *choprai* Alexander (western Himalayas), is likewise allied but with quite distinct venation.

GONOMYIA (PTILOSTENODES) AMICULA sp. nov. Plate 1, fig. 18; Plate 4, fig. 40.

General coloration black, only the scutellum obscure yellow; wings with a very faint brownish tinge; male hypopygium with the outer dististyle a flattened curved blade, at apex produced into two points.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments passing from oval to cylindrical; terminal segment longer than the penultimate; verticils a little exceeding the segments. Head dull black, sparsely pruinose.

Pronotum and mesonotum dull black, the scutellum obscure yellow. Pleura black, the surface of the posterior sclerites weakly pruinose. Halteres and legs black. Wings (Plate 1, fig. 18) with a very faint brownish tinge; veins black, very conspicuous. Venation: Sc_1 ending opposite origin of Rs, Sc_2 far from its tip, just beyond midlength of the vein; cell 2d M_2 small, about one-third its petiole; m-cu more than its own length before the fork of M.

Abdomen, including hypopygium, black. Male hypopygium (Plate 4, fig. 40) with the ventral lobe, *vb*, of basistyle clavate, with scattered setigerous punctures, with larger spinous setæ at apex. Outer dististyle, *od*, a flattened curved blade, produced at apex into two points, the lower one longer and more acute. Inner dististyle, *id*, much longer, at near two-thirds the length bearing a conspicuous, subappressed, flattened, black spine, the style beyond this point glabrous; basad of spine on inner face with abundant suberect setulæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

There are now four distinct species of the subgenus *Ptilostenodes* so far made known, these being *javanica* Alexander (Java), *ptilostenella* Alexander (Luzon), *ptilostenoides* Alexander (Formosa), and the present fly. The last species is separated from the previously described forms by the almost uniform black coloration of the body, antennæ, legs, and halteres, the other species having the body conspicuously variegated with yellow. The male sex of only a single species (*ptilostenella*) was previously known. The male of the present fly shows that excellent characters exist in the male hypopygium of members of the subgenus.

GONOMYIA (GONOMYIA) OCTOSPINOSA sp. nov. Plate 1, fig. 19; Plate 4, fig. 41.

Belongs to the *subcinerea* group; rostrum light yellow; antennæ black throughout; mesonotal præscutum, scutal lobes, and mediotergite chiefly grayish brown; legs black; wings tinged with brown, the prearcular and costal regions clear light yellow; Sc long, Sc_1 ending about opposite one-third the length of Rs; m-cu shortly beyond the fork of M; male hypopygium with each inner dististyle bearing three black spines; phallosome subtended by two black spines.

Male.—Length, about 5 millimeters; wing, 5.8.

Rostrum light yellow; palpi black. Antennæ black throughout; outer flagellar segments becoming very thin and attenuated. Head grayish brown.

Mesonotal præscutum almost covered by a grayish brown shield, composed of entirely confluent præscutal stripes, the humeral region yellow; median region of scutum and posterior portions of scutal lobes yellow, the centers of the lobes grayish brown; scutellum yellow, the parascutella a trifle more obscure;

mediotergite dark brown, each anterolateral angle restrictedly yellow. Pleura somewhat crushed in the unique type but apparently clear light yellow throughout. Halteres with the stem pale yellow, the knobs weakly infuscated. Legs with the coxæ and trochanters yellow; remainder of legs brownish black. Wings (Plate 1, fig. 19) with a brownish tinge, the prearcular and costal regions clear light yellow; stigmal region very vaguely darkened; veins brown, luteous in the yellow areas. Venation: Sc relatively long, Sc_1 ending about opposite one-third the length of Rs, Sc_2 subobsolete, near tip of Sc_1; R_{2+3+4} elongate, only a little shorter than Rs; m-cu about one-third its length beyond the fork of M.

Abdominal tergites dark brown, the sternites yellow. Male hypopygium (Plate 4, fig. 41) with the apical lobe of basistyle, *b*, less than one-third the long fleshy outer dististyle, *od*. Inner dististyle, *id*, with three black spines, the more basal one on outer margin slender and straight, bearing a powerful seta at its base; outer spine long and flattened; a broad-based discal spine about intermediate in length between the two marginal ones. Phallosome, *p*, with two long, slender, blackened spines, arising near base of ædeagus, *a*.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

Gonomyia (*Gonomyia*) *octospinosa* is quite distinct from the other regional species of the genus in the unusual development of spines on the male hypopygium, there being a total of eight, with three on each inner dististyle and two subtending the phallosome.

ERIOPTERA (ILISIA) POSTREMA sp. nov. Plate 1, fig. 20.

Belongs to the *areolata* group; size large (wing, female, 5.4 millimeters); general coloration of head and thorax gray; halteres pale yellow; legs brownish black; wings almost uniformly cream-yellow, the stigma elongate, pale brown; veins yellow, poorly delimited against the ground; Sc_2 only a short distance beyond the origin of Rs; cell 2d A narrow; abdomen black.

Female.—Length, about 5 millimeters; wing, 5.4.

Rostrum and palpi black. Antennæ dark brown throughout; flagellar segments truncated oval, the verticils exceeding the segments; terminal segment a little more than one-half the penultimate. Head blackish, pruinose.

Anterior lateral pretergites very obscure yellow. Mesonotum gray, the præscutum with extremely vague indications of darker stripes; pseudosutural foveæ and tuberculate pits dark brown. Pleura dark gray throughout. Halteres pale yellow. Legs with the coxæ dark brown; trochanters yellowish brown; remainder of legs brownish black. Wings (Plate 1, fig. 20) almost uniformly cream-yellow, the prearcular and costal areas clearer light yellow; stigma elongate, pale brown; veins yellow, poorly delimited against the ground; no darkening of veins along cord, as in *subareolata;* macrotrichia pale brown. Venation: Sc_1 ending shortly beyond R_2, Sc_2 less than twice its own length beyond origin of Rs; cell 1st M_2 small, as in the group; veins M_3, M_4, and Cu_1 strongly upcurved at tips; vein 2d A nearly straight.

Abdomen black, the elongate valves of ovipositor dark horn-color; bases of hypovalvæ and the genital segment blackened.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

In its dark gray thoracic color, with black legs and abdomen, the present fly differs notably from all its allies in eastern Asia. Compared with *Erioptera* (*Ilisia*) *subareolata* Alexander, likewise from western China, the present fly is readily told by the gray thorax and blackened legs.

ORMOSIA LATAURATA sp. nov. Plate 1, fig. 21; Plate 4, fig. 42.

Belongs to the *nigripila* group; general coloration black, the præscutum reddish brown; antennæ yellow, the bases of the flagellar segments narrowly infuscated; legs of male with basal half of femora black, the outer half golden yellow, tibiæ and basitarsi yellow; legs of female black, the extreme tips of femora and bases of tibiæ pale yellow; wings dark brown, abundantly dotted and spotted with white; male hypopygium with the outer arm of dististyle very long and slender; longest gonapophysis a slender, gently curved spine, gradually narrowed to the acute tip.

Male.—Length, about 3.5 to 3.7 millimeters; wing, 4.3 to 4.4.

Female.—Length, about 4.5 millimeters; wing, 4.5.

Male.—Rostrum and palpi black. Antennæ relatively long, if bent backward extending to near middistance between roots of wings and halteres; antennæ yellow, the bases of the flagellar segment narrowly darkened, the amount of the latter color in-

creasing on the outer segments; flagellar segments elongate, with very long verticils at near midlength of the segments, these unilaterally arranged, together with a dense, erect, pale pubescence. Head brownish black.

Pronotum dark brown. Mesonotal præscutum rich reddish brown, without evident markings; posterior sclerites of mesonotum black, sparsely pruinose. Pleura black, sparsely pruinose. Halteres pale yellow, the stem slightly darkened at outer end, the knob golden yellow. Legs with the coxæ and trochanters black; femora black on basal half, the distal half or slightly less golden yellow, including the setæ, the proportion of yellow to black being slightly less on posterior legs where about two-fifths of the segment is brightened; tibiæ and basitarsi yellow, the outer tarsal segments brownish black. Wings (Plate 1, fig. 21) dark brown, abundantly dotted and spotted with white, all such spots being relatively small; larger white areas include the origin of Rs, Sc_2, Sc_1, and R_2; along cord and outer end of cell 1st M_2; marginal spots at R_{1+2}, R_3, R_4, and 1st A, the remaining marginal spots small; lesser markings include white droplets in outer radial field and in most of the cells basad of the cord, these areas variable in number and position; costal pale areas somewhat more yellowish white; veins dark, white and almost obliterated in the pale areas. Trichia of cells black, weaker and pale yellow in the white areas. Venation: Cell 1st M_2 closed; m-cu sinuous, shortly before fork of M; anal veins divergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 4, fig. 42) of the general structure of the group, but the outer lobe of the outer dististyle, *od*, of unusual length and slenderness. Inner dististyle, *id*, likewise unusually long and narrow, with four long setæ, beginning at the weakly angulated middle portion of the style, the outer seta placed on face of style remote from margin. Longest gonapophyses, *g*, appearing as long, very slender, acute spines that are gently curved.

Female.—Generally as in male. Antennæ shorter but similarly bicolorous. Femora and tibiæ black, only the extreme tip of the former and base of the latter pale yellow; tarsi black.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Nwa Nien Pin Temple, altitude 6,500 feet, July 31, 1935 (*Franck*). Allotopotype, female, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, July 27, 1935. Paratopotypes, 2 males, with the type; 1 male with the allotype.

Ormosia lataurata and the species next described as *O. angustaurata* sp. nov. are among the most beautiful and distinct species of the genus so far made known. There is no closely related species so far described, but the two forms themselves are closely allied, differing most evidently in the antennal and leg coloration, wing pattern, and structure of the male hypopygium.

ORMOSIA ANGUSTAURATA sp. nov. Plate 4, fig. 43.

Male.—Length, 4 to 4.5 millimeters; wing, 4.7 to 5.

Female.—Length, about 4 millimeters; wing, 4.5.

Closely allied to *O. lataurata* sp. nov., differing as follows:

Male.—Antennæ with basal segments yellow, those of outer half passing into dark brown, the individual segments not bicolorous, as in *lataurata.* Mesonotum somewhat darker, more infuscated. Legs with the femora black, the tips narrowly yellow; tibiæ obscure yellow; basitarsi obscure yellow, the tips narrowly darkened; remaining tarsal segments infuscated. Wings pale brown, with a conspicuous white pattern, the general arrangement much as in *lataurata,* but the areas larger and restricted to the vicinity of the veins; small droplets of *lataurata* lacking or greatly restricted in number; white areas at ends of anal veins large and conspicuous. In the holotype the pale costal areas at origin of Rs, Sc_2, and Sc_1 are very large, reaching the costal border. Male hypopygium (Plate 4, fig. 43) much as in *lataurata,* especially as regards the outer dististyle, *od.* Inner dististyle, *id,* with five elongate setæ, the more basal near upper margin of style, the outermost close to the ventral edge. Gonapophyses, *g,* of entirely different structure from those of *lataurata,* the chief pair appearing about as illustrated.

Female.—Generally as in male, differing in the sexual characters. Tibiæ and tarsi dark brown or brownish black, a little paler than the femora.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female. Paratopotypes, 2 males.

The two species of the *nigripila* group of *Ormosia* herewith described as *O. lataurata* and *O. angustaurata* bear a surprising superficial resemblance to various members of the subgenus *Mesocyphona* of the genus *Erioptera* in the Nearctic and Neotropical faunas, and to members of the *alboguttata* group of the typical subgenus *Erioptera* in eastern Asia.

ORMOSIA CURVISPINA sp. nov. Plate 1, fig. 22; Plate 4, fig. 44.

Belongs to the *similis* group; general coloration dull brownish black; antennæ (male) short; legs black; wings with a brown tinge; vein 2d A sinuous; abdomen, including hypopygium, black; male hypopygium with the inner arm of the outer pair of gonapophyses very strongly curved into a long black spine.

Male.—Length, about 3.8 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ (male) short, if bent backward ending at or a short distance before wing root, black throughout; flagellar segments oval, the verticils of the basal segments very long and conspicuous, the longest exceeding three times the length of the segment; beyond the fourth or fifth segments the verticils become shorter, on the outer ones being scarcely as long as the segments themselves. Head black.

Pronotum black, sparsely pruinose. Anterior lateral pretergites very restrictedly obscure yellow. Mesonotal præscutum dull brownish black, very sparsely pruinose, without markings; posterior sclerites of mesonotum brownish black. Pleura, including the dorsopleural region, dull black. Halteres with stem obscure, the knob light yellow. Legs with the coxæ brownish black; trochanters obscure yellow; remainder of legs black. Wings (Plate 1, fig. 22) with a brownish tinge, the stigmal region infuscated; veins brown, relatively stout; macrotrichia black. Trichia of the cells indicated in the figure by stippled dots. Venation: Sc_2 about opposite two-fifths the length of Rs; R_{2+3} about one-third R_2 alone; outer fork of M perpendicular at origin, not angulated at point of union of m and the distal section of vein M_3; m-cu close to fork of M; vein 2d A sinuous on the outer third or less.

Abdomen, including the hypopygium, black. Male hypopygium (Plate 4, fig. 44) with the ninth tergite, 9*t*, having the lateral lobes rounded, the structure divided by a profound median split; outer face with very delicate setulæ arranged in elongate-oval areas. Inner dististyle, *id*, unusually deep, with a slender apical beak, the entire outer margin, including the crest, narrowly blackened. Outer gonapophyses, *og*, bifid, the outer arm a black spike that bears a small lateral spine at near two-thirds the length; inner arm a powerful, strongly curved, black spine, the tip acute. Inner gonapophyses, *ig*, an even longer, gently curved spine, much paler in color than the outer apophyses, the apex slender and acute.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

Ormosia curvispina is entirely different from all other regional species of the *similis* group. As is usually the case in this and most other genera in the Tipulidæ, the chief specific characters are to be found in the structure of the male hypopygium.

ORMOSIA SOLITA sp. nov. Plate 1, fig. 23; Plate 4, fig. 45.

Belongs to the *aculeata* group; general coloration of mesonotal præscutum reddish brown, without distinct markings; antennæ dark brown, in the male the intermediate flagellar segments with verticils of an unusual length; halteres yellow; legs yellow, the femora with a narrow, subterminal, brown ring; wings brownish gray, variegated by light and darker areas, including a conspicuous white area beyond stigma; cell R_3 of moderate length only, vein R_3 strongly upcurved at margin; vein 2d A with nearly the outer half sinuous.

Male.—Length, about 4 millimeters; wing, 4.8.

Female.—Length, about 4.5 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ of moderate length, dark brown throughout; flagellar segments subcylindrical, with unusually elongate verticils (male), on the intermediate segments these much exceeding the segments in length, on the outer segments becoming small and weak; terminal segment subequal in length to the penultimate. Head blackish gray, with yellow setæ.

Pronotum brown, the anterior lateral pretergites dirty white. Mesonotal præscutum reddish brown, without distinct markings, the interspaces with long yellow setæ; scutellum dusky; mediotergite and pleura blackish, the surface sparsely pruinose. Halteres yellow. Legs with the coxæ blackened; trochanters obscure yellow; femora yellow, with a narrow darkened subterminal ring that is subequal to or slightly more extensive than the yellow apex; indications of a second darkened ring, especially on forelegs, extensive but very diffuse and located nearer base of segment; tibiæ and tarsi yellow, the outer segments of the latter darkened. Wings (Plate 1, fig. 23) with a brownish gray tinge, sparsely variegated with darker, including the stigma and narrow seams along cord and outer fork of M; more whitish areas before cord and beyond stigma, the former crossing the cord into the base of cell M_3; outer end of cell M

less evidently darkened; surface of wing with abundant macrotrichia, these being black and coarser in the clouded patches, more delicate and pale yellow in the clear areas and elsewhere over the wing surface in scattered patches; costal fringe variegated with black and yellow setæ; veins brownish yellow, darker and narrowly seamed with dusky in certain regions of the wing. Macrotrichia of cells abundant (shown in figure by stippled dots). Venation: R_2 at or beyond fork of R_{3+4}; outer fork of M not angulated; m-cu conspicuously arcuated at near midlength; vein 2d A strongly sinuous, the arcuated portion occupying nearly one-half of the entire vein beyond arculus.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 4, fig. 45) with the tip of the basistyle, *b*, terminating in an acute sclerotized point. Dististyles subterminal in position, the inner one, *id*, strongly arcuated before midlength, the apex dilated into a head that terminates in an acute spine.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female, Nwa Nien Pin Temple, altitude 6,500 feet, July 31, 1935.

The other members of the *aculeata* group, as *aculeata* Alexander (Japan), *anthracopoda* Alexander (Formosa), *horiana* Alexander (Japan), and *lævistyla* Alexander (Japan), are all readily told by the different structure of the male hypopygia. The most similar regional species is *Ormosia auricosta* Alexander, of which the male sex is still unknown. The last species differs especially in the larger size and distinct features of venation and pattern of the wings, as the more extensively pale costa, the lack of a white poststigmal area, the presence of conspicuous marginal dark dots at ends of the longitudinal veins, and the feebly sinuous vein 2d A. It seems virtually certain that *auricosta* will likewise be found to belong to the *aculeata* group of the genus, although the somewhat similar *O. præcisa* Alexander is a member of the distinct *similis* group.

STYRINGOMYIA ANGUSTIPENNIS sp. nov. Plate 1, fig. 24.

General coloration medium brown; antennal flagellum yellow; femora obscure yellow, with two weak and diffuse brown rings; tibiæ with tips narrowly darkened and with a vague second ring at near basal third; wings narrow, especially near base, tinged with brownish yellow, unmarked; veins beyond costal area brown, contrasting against the ground; ovipositor with the longest valves blackened, glabrous, terminating in two long strong setæ.

Female.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi brown. Antennæ with the scape brown, darker beneath; pedicel brownish yellow; flagellum yellow; flagellar segments oval, gradually decreasing in length outwardly. Head yellowish brown.

Mesonotum discolored in type, apparently medium brown, variegated by darker brown areas, especially on the posterior sclerites. Pleura crushed. Legs with the femora obscure yellow, weakly biannulate with pale brown, the subterminal ring narrower than the yellow apex, the postmedial ring very diffuse; tibiæ yellow, the tip narrowly infuscated, with very vague indications of a second annulus near basal third of segment; basitarsi yellow, the outer tarsal segments slightly darkened, especially apically, the terminal segment black. Wings (Plate 1, fig. 24) tinged with brownish yellow, unpatterned, the costal portion somewhat clearer yellow, especially the veins; veins beyond the costal portion brown, contrasting against the ground. Wings narrow, especially near base, best shown by narrowing of the cubital and anal cells. Venation: Cell 1st M_2 elongate, nearly equal in length to the longest veins beyond it; m-cu a little more than its own length beyond the fork of M; vein 2d A simple, the cell narrow.

Abdomen uniformly light brown. Ovipositor with the longest valves, apparently cerci, appearing as long blackened cones, the surface glabrous, at apex of each with two, long, powerful setæ that are a little longer than the valve itself; a further shorter seta on outer face near base.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

The nearest regional allies of the present fly are species such as *Styringomyia flava* Brunetti (southern India) and *S. taiwanensis* Alexander (Formosa), which have similarly unpatterned wings and simple vein 2d A. The present fly is well distinguished from the above and other generally similar regional forms by the brown veins that contrast strongly with the ground color of the unusually narrow wings.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *at*, antenna; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *ig*, inner gonapophysis; *od*, outer dististyle; *og*, outer gonapophysis; *p*, phallosome; *s*, sternite; *t*, tergite; *vb*, ventral lobe of basistyle; *vd*, ventral dististyle.]

Plate 1

Fig. 1. *Tipula* (*Trichotipula*) *longifimbriata* sp. nov.; venation.
2. *Tipula* (*Trichotipula*) *mallophora* sp. nov.; venation.
3. *Tipula* (*Schummelia*) *membranifera* sp. nov.; venation.
4. *Tipula* (*Schummelia*) *dissociata* sp. nov.; venation.
5. *Tipula* (*Acutipula*) *forticauda* sp. nov.; venation.
6. *Tipula* (*Acutipula*) *subintacta* sp. nov.; venation.
7. *Tipula* (*Vestiplex*) *avicularoides* sp. nov.; venation.
8. *Tipula* (*Oreomyza*) *prolongata* sp. nov.; venation.
9. *Stibadocerella omeiensis* sp. nov.; venation.
10. *Limonia* (*Limonia*) *omniflava* sp. nov.; venation.
11. *Limonia* (*Limonia*) *tessellatipennis* sp. nov.; venation.
12. *Limonia* (*Dicranomyia*) *sternolobata* sp. nov.; venation.
13. *Adelphomyia* (*Adelphomyia*) *cerina* sp. nov.; venation.
14. *Phyllolabis laudata* sp. nov.; venation.
15. *Phyllolabis vulpecula* sp. nov.; venation.
16. *Franckomyia discalis* sp. nov.; venation.
17. *Trentepohlia* (*Mongoma*) *enervata* sp. nov.; venation.
18. *Gonomyia* (*Ptilostenodes*) *amicula* sp. nov.; venation.
19. *Gonomyia* (*Gonomyia*) *octospinosa* sp. nov.; venation.
20. *Erioptera* (*Ilisia*) *postrema* sp. nov.; venation.
21. *Ormosia lataurata* sp. nov.; venation.
22. *Ormosia curvispina* sp. nov.; venation.
23. *Ormosia solita* sp. nov.; venation.
24. *Styringomyia angustipennis* sp. nov.; venation.

Plate 2

Fig. 25. *Tipula* (*Trichotipula*) *longifimbriata* sp. nov.; male hypopygium, details.
26. *Tipula* (*Trichotipula*) *mallophora* sp. nov.; male hypopygium, details.
27. *Tipula* (*Schummelia*) *membranifera* sp. nov.; male hypopygium, details.
28. *Tipula* (*Schummelia*) *dissociata* sp. nov.; male hypopygium, details.
29. *Tipula* (*Acutipula*) *forticauda* sp. nov.; male hypopygium, details.
30. *Tipula* (*Acutipula*) *subintacta* sp. nov.; male hypopygium, details.

PLATE 3

FIG. 31. *Tipula* (*Vestiplex*) *avicularoides* sp. nov.; male hypopygium, details.
32. *Tipula* (*Oreomyza*) *prolongata* sp. nov.; male hypopygium, details.
33. *Limonia* (*Limonia*) *omniflava* sp. nov.; male hypopygium.
34. *Limonia* (*Limonia*) *tessellatippennis* sp. nov.; male hypopygium.
35. *Limonia* (*Dicranomyia*) *sternolobata* sp. nov.; male hypopygium.
36. *Adelphomyia* (*Adelphomyia*) *cerina* sp. nov.; male hypopygium.
37. *Phyllolabis laudata* sp. nov.; male hypopygium.
38. *Phyllolabis pictivena* Alexander; male hypopygium, details.

PLATE 4

FIG. 39. *Franckomyia discalis* sp. nov.; antenna, male hypopygium.
40. *Gonomyia* (*Ptilostenodes*) *amicula* sp. nov.; male hypopygium.
41. *Gonomyia* (*Gonomyia*) *octospinosa* sp. nov.; male hypopygium.
42. *Ormosia lataurata* sp. nov.; male hypopygium.
43. *Ormosia angustaurata* sp. nov.; male hypopygium.
44. *Ormosia curvispina* sp. nov.; male hypopygium.
45. *Ormosia solita* sp. nov.; male hypopygium.

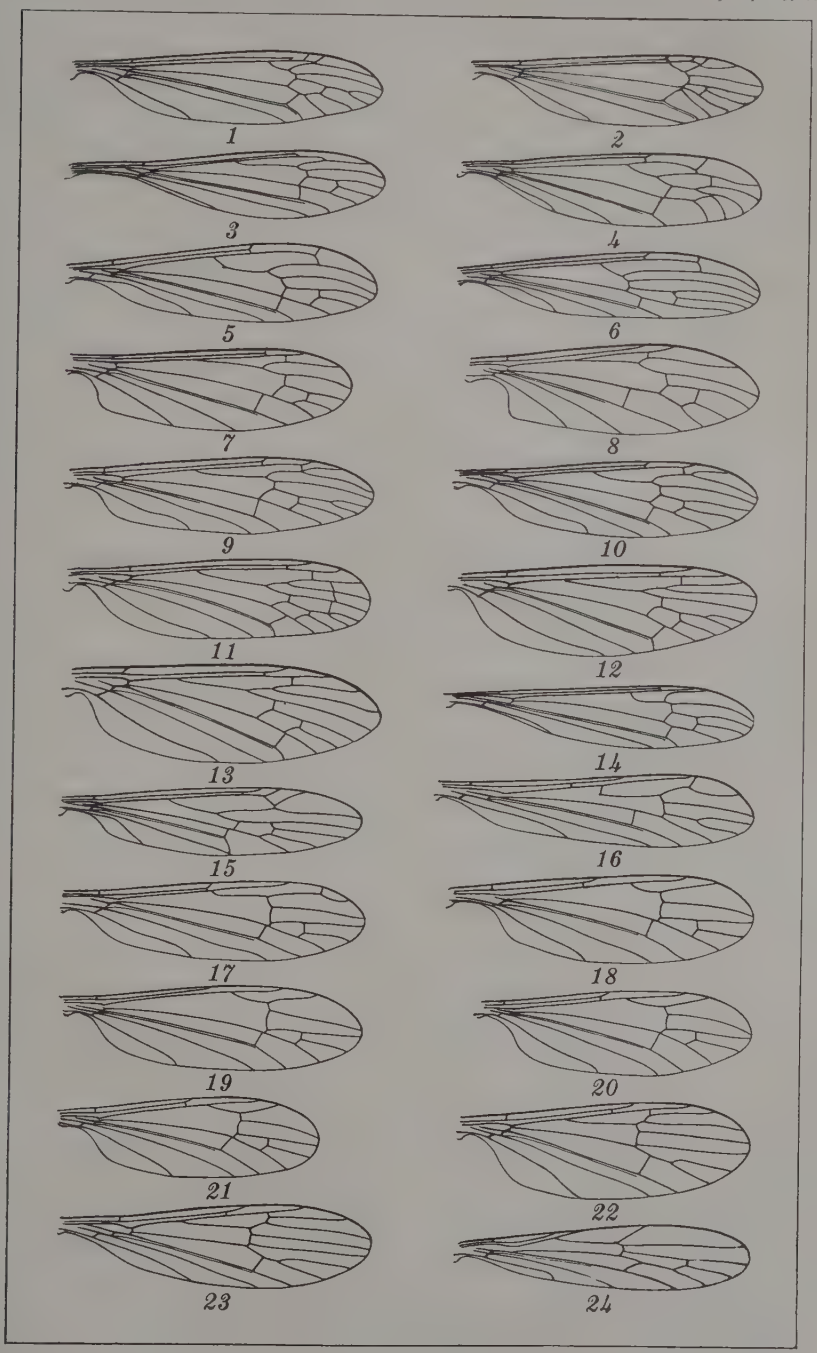

PLATE 1.

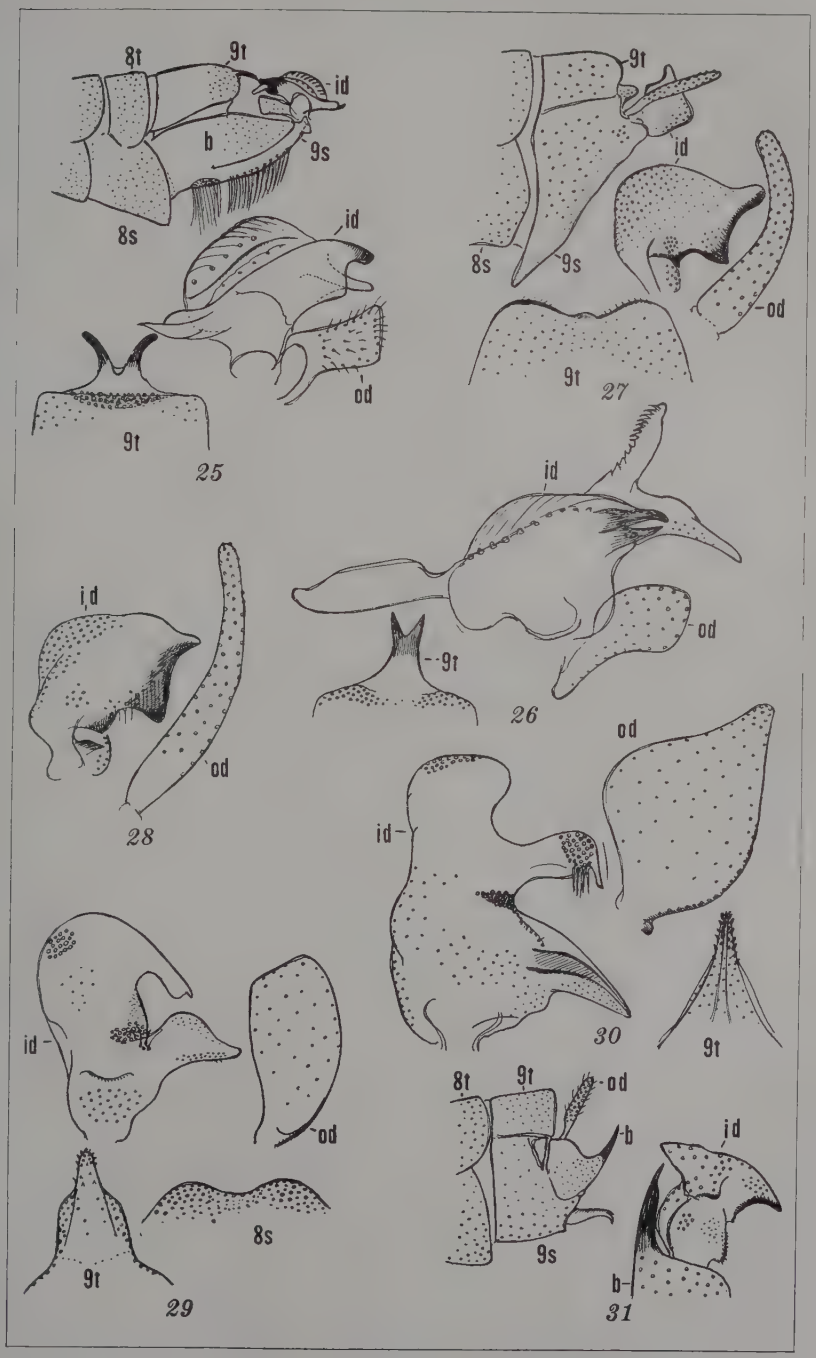
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PLATE 2.

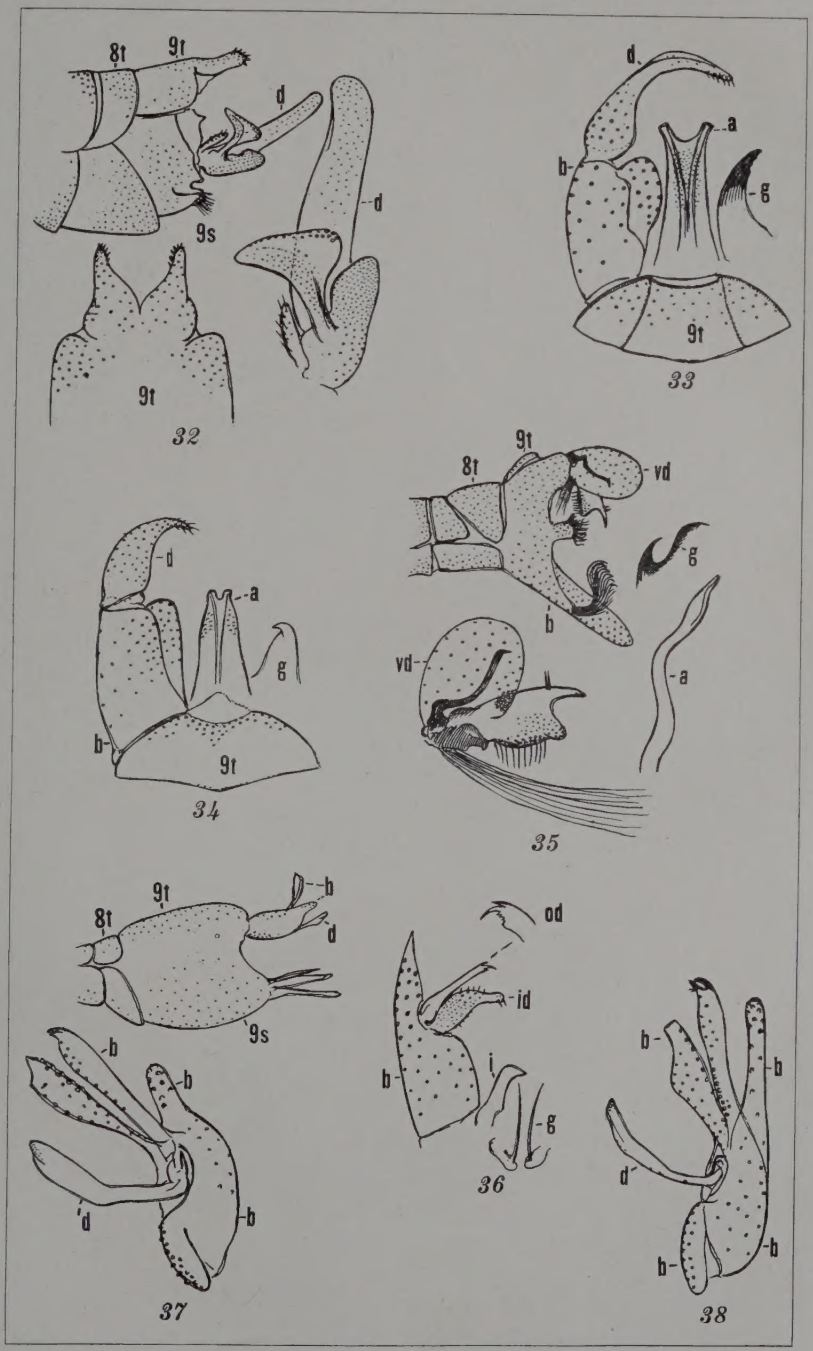
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PLATE 3.

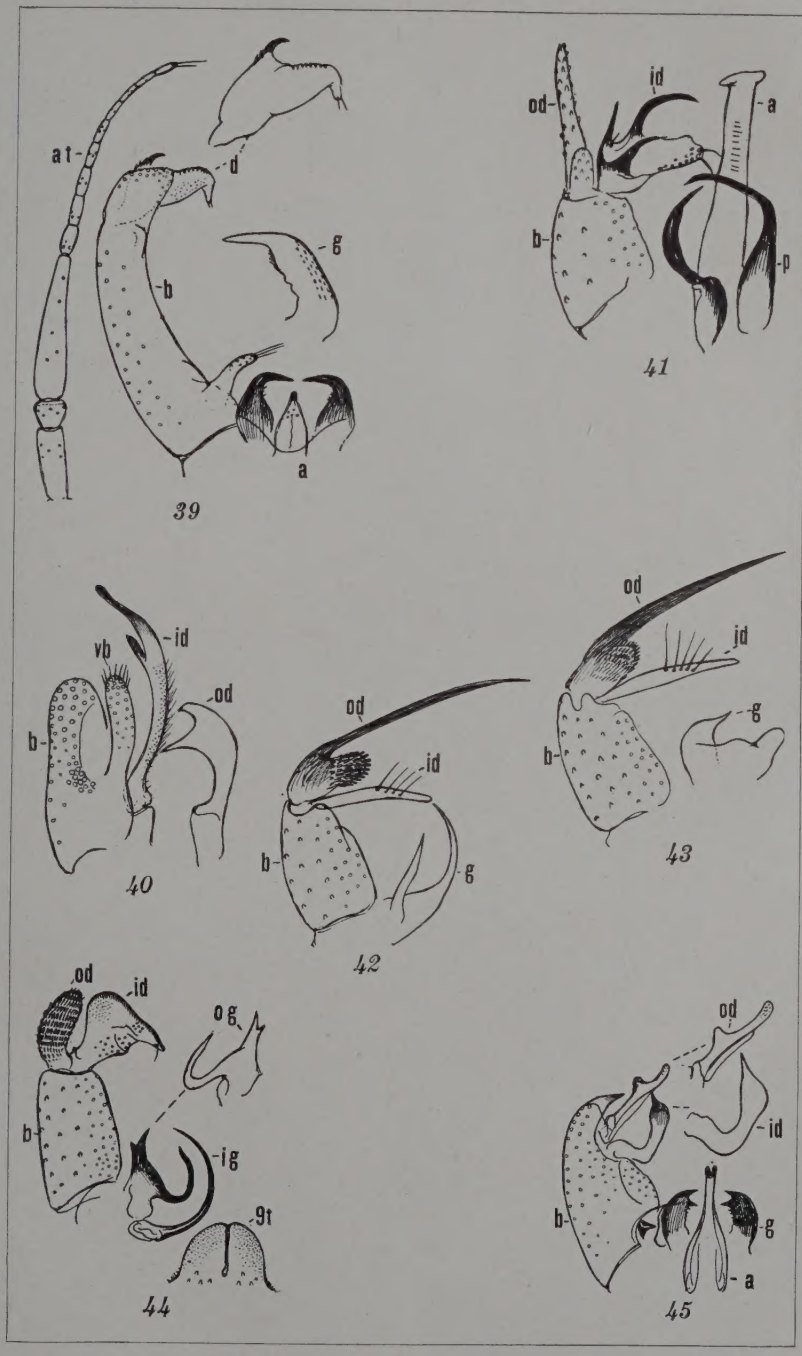
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PLATE 4.